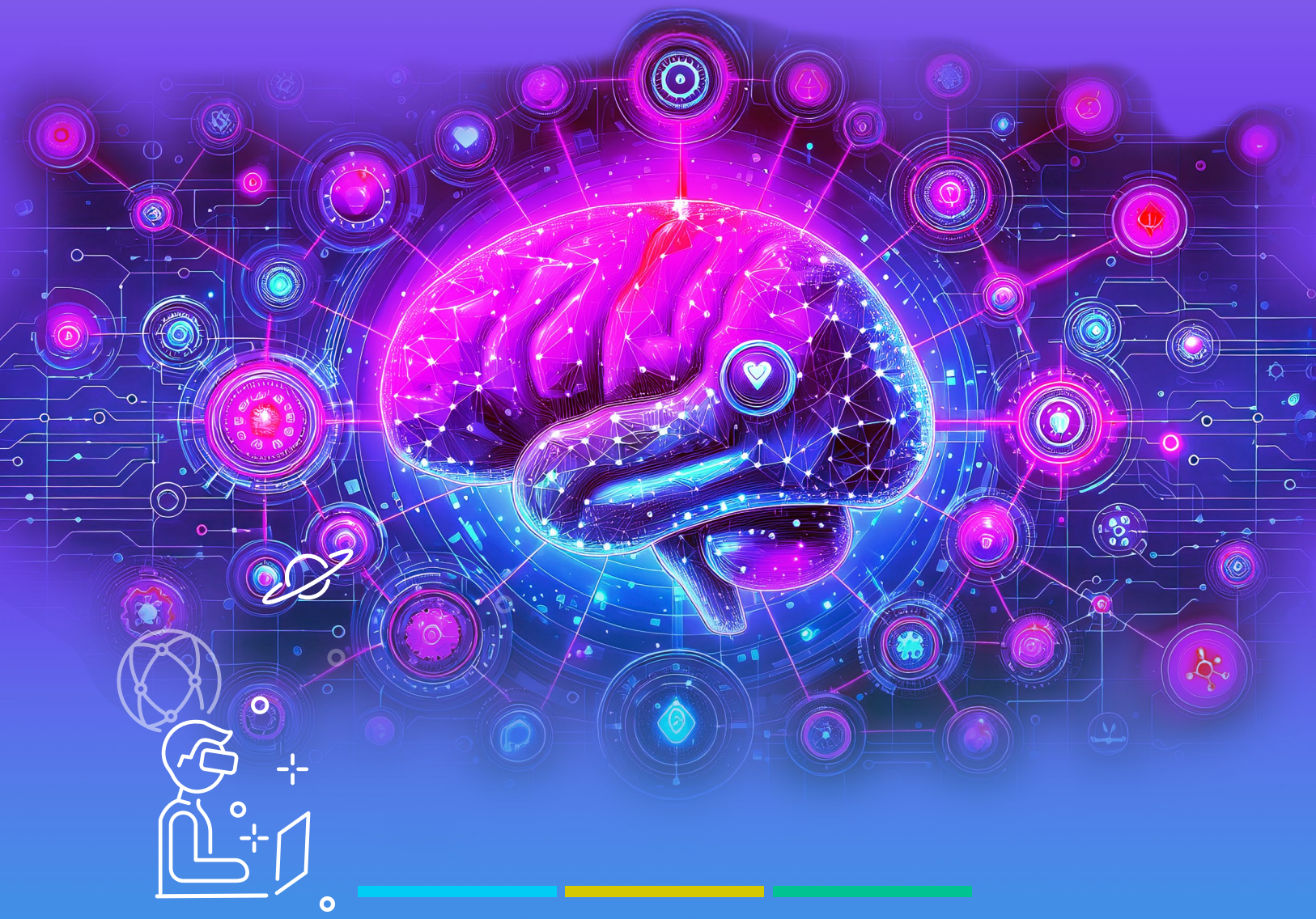

Artificial Intelligence Futures for the Arab Region

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ESCWA, an innovative catalyst for a stable, just and flourishing Arab region

MISSION

Committed to the 2030 Agenda, ESCWA's passionate team produces innovative knowledge, fosters regional consensus and delivers transformational policy advice. Together, we work for a sustainable future for all.

Economic and Social Commission for Western Asia

E/ESCWA/OES/2025/1

Artificial Intelligence Futures for the Arab Region

United Nations publication issued by ESCWA, United Nations House, Riad El Solh Square, P.O. Box: 11–8575, Beirut, Lebanon.

Website: www.unescwa.org.

Cover photo credit: ©iStock.com

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Preface

This report is the third in a series of analyses from the United Nations Economic and Social Commission for Western Asia (ESCWA) on megatrends.

In his 2021 report on "Our Common Agenda", the United Nations Secretary General described that "now is the time to think for the long term, to deliver more for succeeding generations and to be better prepared for the challenges ahead". The commitments called for in Our Common Agenda include "convening foresight and planning experts … and regularly reporting on megatrends". ESCWA has been advancing these commitments since 2021 in a variety of ways, including through this series of megatrend studies (Electric mobility, December 2022; Metaverse, August 2024).

Megatrends are socioeconomic-technical phenomena that have reached a point at which they are transforming the dominant patterns of life and work that shape the lives of billions of people today. They disrupt existing economic, financial, social-cultural, environmental and other societal conditions, and create wholly new conditions. The effects are almost always a mix of beneficial and harmful. They demand policy and other actions by leaders across sectors to strengthen and take advantage of the potential positive impacts while mitigating the potential harms.

In 2025, artificial intelligence (AI) might be considered the quintessence of a megatrend. While the technology has been developed and in use for more than six decades, it has metamorphosed in recent years into a force affecting a growing number of facets of human life. It is changing how products are manufactured, how schools teach, how cities are designed, how healthcare innovations are invented and applied, and much more – all in ways that we have only barely begun to recognize or understand.

AI is advancing in all these fields in the Arab region today. The pace and nature of this advancement will be distinctive to the countries and people of the region. The purpose of this report is to explore what that could look like and what the

implications of different choices and priorities could be. Its aim is not to prescribe, but rather the opposite – to provide policymakers and leaders in other sectors in the Arab region with a combination of facts, projections and ideas about AI that open their minds and their decision-making processes to a range of possibilities.

The time for Arab region leaders to engage with the AI megatrend is now, through policy, investment and other types of actions, in support of key aims of the Pact for the Future adopted in September 2024. Doing so represents a singular opportunity to actively shape desirable futures for the peoples of the region today and for generations to come, taking advantage of this transformational technology, and of the social and economic and other changes it is unleashing.

Shaping the future is not only possible, it is imperative. It requires proactive steps to understand what the possibilities could be, followed by actions to leverage that understanding. This report is a contribution to that understanding.

Acknowledgements

The United Nations Economic and Social Commission for Western Asia (ESCWA) appreciates the valuable contributions of the following individuals and organizations to this study and report.

ESCWA core team

Mounir Tabet, Deputy Executive Secretary

Youzhi Zhang, Associate Programme Management Officer

Leen Abdallah, Research Assistant

Partner organizations

The Middle East Institute, Washington, D.C., United States

IE University Center for the Governance of Change, Madrid, Spain

International Telecommunication Union, Geneva, Switzerland

American University of Beirut, Beirut, Lebanon

Report authors

Steven Kenney, Director, Strategic Foresight Initiative, The Middle East Institute , Lead Author

Mariette Awad PhD (Associate Professor, Electrical and Computer Engineering Department, The American University of Beirut)

Thomas Basikolo PhD (AI for Good Program Officer, International Telecommunication Union)

Nagla Rizk PhD (Professor of Economics and Founding Director, Access to Knowledge for Development Center, The American University in Cairo's Onsi Sawiris School of Business)

Dario Garcia de Viedma (Associate Director, Center for the Governance of Change, IE University)

The Middle East Institute research and analysis support

Omar Abdelrahman

Noora Alozaibi

Aziza Ben Abdallah

Gili Golan

Esther Mohadeb

Luke DuBree Morton

IE University

Jaime De Aguinaga Garcia

Carlos Luca De Tena

Giaccomo Ugarelli

Milica Blagojević

The American University in Cairo

Khadiga Hassan

Nada Nassar

Experts interviewed

Lama al Arabiat

Muath Alduhishy

Hamish Campbell

Achref Chibani

Sofia Kyriazi

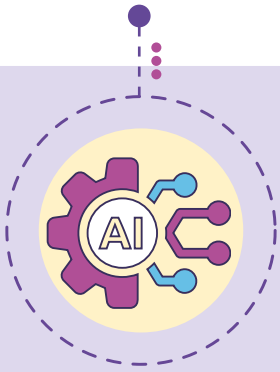
Moises Maldonado

Rebeca Moreno Jimenez

Jessica Obeid

Mohammed Soliman

Executive summary



At the end of 2024,
90 per cent of Fortune 500 companies were using AI.
A recent estimate projected
$23 trillion in annual economic value from AI **by 2040.**

While artificial intelligence (AI) is far from an overnight sensation, the release of ChatGPT in November 2022 was a defining moment. It mobilized the global tech sector, corporations in other sectors, Governments and global investors. At the end of 2024, 90 per cent of Fortune 500 companies were using AI. A recent estimate projected $23 trillion in annual economic value from AI by 2040.[1]

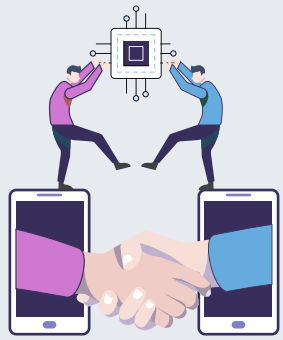
The impact of AI on humanity and society is already great today, and is scaling rapidly. In five years' time, this moment in time will seem modest in comparison. Most projections for the decade between 2030 and 2040 show exponential increases in what the world has seen to date. Leaders must juxtapose incredible societal benefits against the challenges and risks that we already face from AI, and that we will see accelerate and scale as the technology does.

The speed of the advancement of AI makes it critical for leaders to contend with both sides of the opportunity and risk equation now. This report provides insights into what we can anticipate regarding the future of AI, to identify decisions and actions that leaders can take today to prepare for tomorrow. In some cases, they are decisions and actions that must be taken for future success.

The present report examines three alternative pathways that AI could take in the Arab region over the next 10 to 20 years. Each represents a direction that the advancement of AI might take in the region that could gain magnitude and momentum over that time period through deliberate strategies with supportive policy and other actions to achieve distinctive aims. The pathways are not mutually exclusive. They can proceed in parallel to varying degrees, and there can be degrees of overlap and complementarity between them.

These are not the only pathways that countries in the Arab region could pursue to leverage AI in their future societies. Whether these pathways or others are pursued, building the capacity to develop and use AI will be essential. Capacity-building is an imperative for every country, not just in the Arab region. The critical decisions for public, private and civil sector leaders will be how to do so in the most appropriate ways given the conditions and starting points unique to each country.

1 Pathway 1: Optimizing diverse AI technologies and partnerships for local priorities



Many countries today are embarking on strategies for domestically developing AI models and other AI research and development capabilities and infrastructure. Locally curated and controlled datasets, a native AI-skilled workforce, governance frameworks and other elements are part of these strategies. But making the technology locally is not the only way countries might think about AI to advance their interests. Some may choose to develop some elements of their AI tech stack locally, while building collaborations with global partners to adapt AI for some of the aims they want to achieve. For some countries in the Arab region, the latter may be an optimal pathway.

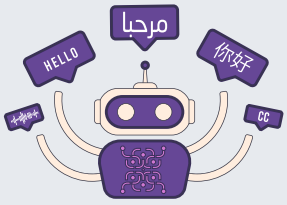
The countries in the Arab region that are currently farthest along in their development and application of AI already benefit from global collaborations which allow them to adapt partners' AI innovations as well as boost their research and development and infrastructure self-reliance. Other countries in the region that are at an earlier stage of creating their AI futures with constrained resources are also forging global partnerships and may benefit even more.

Most indicators of the growing attention in the Arab region to partnering for AI adaptation involve government entities on one or both sides of the agreements. Business-to-business international partnerships are proliferating as well and can be equally or even more important. There are also growing cross-sectoral intra-regional collaborations helping countries adapt AI for their distinctive priorities. In addition to bilateral collaborations, several intra-regional forums have emerged.

Smart strategic use of open-source software and algorithms will be an increasingly powerful additional means of partnering to adapt global AI innovations to countries' priorities. Open source is a means for working in real time with a global community of developer partners that numbers in the millions. Bringing Arab region diaspora experts into structured collaborations in their countries of origin could be another resourceful way to adapt AI innovations to local priorities.

Many Arab region countries have long-term national visions, offering opportunities to adapt AI to established plans for the future. There are also new national AI strategies in a number of Arab region countries. Countries can forge pathways that explicitly link what they prioritize in their partnerships for adapting AI to goals and priorities in their national visions or other country-level policies. They can consider how goals, priorities and objectives in these national visions can be advanced by AI in ways that were never previously possible. They can also consider new goals, priorities and objectives that might be added to their visions that can be advanced by AI.

2 Pathway 2: AI and identity in the Arab region



A second pathway could see investment in AI in service to objectives rooted less in individual nations' priorities, and more in the Arab region's language, cultures and identity more broadly. One dimension of this pathway is to accelerate and scale the development and use of AI models built on Arabic-centric data (Arabic language text and data in other forms like images, video and audio). Another dimension is the opportunity countries have to safeguard and nurture their cultural heritage in ways never before possible, via AI applications that preserve, recover, and restore manifestations of those cultures for future generations.

Investing in creating generative AI tools built and trained on Arabic language data and other types of data that reflect the region's values, culture and peoples will transform businesses, government ministries, and other types of enterprises in Arab countries. Progress on Arabic large language models (LLMs) and other generative AI tools is accelerating in the region and elsewhere, driven by at least three forces. One is recognition of the economic growth it can fuel. The second is recognition of the prospects it offers for positioning in the global tech economy. The third is recognition of the inherent value of reflecting native language and culture in how AI is utilized in everyday work and life.

With a growth of Arabic language AI models and applications, consumers in the Arab region will see significant improvements in their experiences as customers in a range of ways, and businesses will gain access to new local and global customers. Essential government services are increasingly provided in Arab region countries through digital means, and Arabic language AI models will transform how citizens engage with their Governments.

Development of Arabic AI models and tools will also help fuel job creation and business creation throughout the region. It will enable high-quality educational content to become more accessible to and engaging for students from different linguistic dialect backgrounds. Generative AI tools capable of performing in the range of Arabic dialects will play an important role in advancing digital equity, opening the AI-enabled future to millions in the region. Arabic language LLMs and generative AI will be a demonstration of the region's growing stature and influence on the global stage.

There is an emerging role for AI in the preservation of cultural heritage. Generative AI can be utilized for reconstructing damaged works of art and historically significant cultural sites. It can translate ancient texts, making them accessible to scholars and to non-experts who might otherwise never be able to engage with them. AI can power immersive virtual environments that recreate long-lost historical sites and figures, making cultural heritage experiential for those who cannot engage with it physically.

The benefits of investing in AI for cultural heritage preservation are significant. They include economic growth from AI-enabled cultural tourism, with accompanying job creation, and the revitalization of neighbourhoods and infrastructure surrounding site restorations. AI will also be instrumental in fostering cross-cultural mutual understanding in a variety of ways, including promoting inclusiveness and empathy within communities and between communities, and in some cases promoting conflict resolution. It will also strengthen Arab region countries' relationships with other countries, helping foster positive perceptions and thereby strengthening their position on the international stage.

3 Pathway 3: AI and the Sustainable Development Goals in the Arab region

Considerable work is being done globally on applying AI to the Sustainable Development Goals (SDGs), and substantial progress is being seen. However, countries around the world are behind on 80 per cent of the 169 targets that comprise the SDG framework.

As AI is accelerating and scaling at an astonishing rate, there is an opportunity for countries to recognize this as a call to action. A third pathway for the advancement of AI in the Arab region is to accelerate and scale the application of AI against specific SDG targets in a deliberate strategic manner, with the aim of closing the gap on the 80 per cent of targets that risk not being met.

In 2024, the United Nations reported on projects underway or planned to develop and deploy AI-enabled systems and tools in support of the SDGs. Nearly 50 agencies within the United Nations system contributed, reporting on more than 400 projects. The work on AI to accelerate SDG progress goes beyond the efforts of United Nations agencies and their multi-sectoral partners, including AI startup companies, the social sector and civil society organizations, and other types of enterprises around the world. All this work represents an important inflection point.

Seizing on this inflection point can be a pathway for AI in the Arab region. At least two attributes could define this pathway. One has to do with prioritization – identifying promising SDG-relevant AI applications to scale beyond the modest levels of their current use. Prioritizing may also need to consider which SDGs, or targets within individual Goals, to focus on in prospective future efforts to scale AI initiatives. The second attribute relates to shifting the focus of funding to the region for these AI efforts. Countries could deliberately target more of their own investment to scaling selected AI developments for selected SDGs. Partnerships with global investors and AI developers to focus more on SDG-supporting initiatives in the Arab region could be another element of a prioritization strategy.

The ability of policymakers and other leaders in the Arab region to visualize this pathway for the future of AI in the Arab region requires appreciating the kinds of outcomes that current efforts to apply AI to the SDGs can create. Chapter 4 of this report provides examples of the potential impacts of scaling selected types of AI tools when applied to the 17 SDGs. The examples are not a prescription for which SDG targets to focus on, or for specific types of AI applications to choose to scale.

Contents

Abbreviations, acronyms and glossary

AI	artificial intelligence
AR	augmented reality
ESCWA	United Nations Economic and Social Commission for Western Asia
ICT	information and communication technologies
IMF	International Monetary Fund
ITU	International Telecommunication Union
IWMI	International Water Management Institute
LLMs	large language models
MLLMs	multi modal large language models
MSME	micro, small and medium enterprise
OECD	Organisation for Economic Co-operation and Development
SDGs	Sustainable Development Goals
SLMs	small language models
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VR	virtual reality

1 Introduction

The recent boom in generative AI has been astonishing. Since the free public release of OpenAI's ChatGPT in November 2022 and its 100 million monthly active users just two months later, it became the fastest growing consumer technology application in human history.[2]

Since 2022, the largest and most powerful companies in the global tech sector have rapidly accelerated the deployment of their own generative AI models – Google's Gemini, Meta's (formerly Facebook) MetaAI and Microsoft's Copilot, to name just three. None of these accomplishments occurred overnight. OpenAI's company launch was in 2015, and the work in AI of Meta, Google and Microsoft that led to their popular tools of today goes back decades. Work on AI by other companies, research institutions, Governments and other entities goes back decades further still. The 1950s is recognized as the era of the birth of a technology that has many other forms rather than just the generative AI.[3]

The ChatGPT launch mobilized not only global tech sector giants, but also global investors looking for startups and preparing to propel a massive wave of transformative AI applications. In the United States, investors have funnelled more than $250 billion into more than 4,500 AI companies cumulatively since 2013. In 2022 alone, more than 500 AI-based startups were founded in the United States, attracting $47 billion in non-government funding. Over the last decade, the top 10 countries globally in terms of number of AI startups combined to found nearly 8,700 companies. That is approximately 12 per cent of the estimated 70,000 AI-based startups in existence in the world today, more than 200 of which were privately-owned startup businesses worth more than $1 billion as of March 2024. Generative AI comprises nearly 50 per cent of all AI funding, "a significant increase from 2022 when generative AI startups garnered only 8 per cent".[4]

The importance of this moment in time is not only in tech sector or entrepreneur windfall. It is in the human and societal impact AI is already having. An estimate in late 2024, puts the economic value of generative AI at $20 trillion by 2030, expected to drive

By late **2024**, **35 per cent** of businesses had adopted AI technologies in their operations, and another **42 per cent** were considering AI for future implementation. AI is being used by more than **50 per cent** of large companies with over **5,000 employees**. More than **90 per cent** of **government** organizations surveyed globally are already using or exploring using AI.

Against the incredible societal benefits introduced above, leaders must juxtapose existing **challenges and risks**, which will accelerate and scale as AI does.

3.5 per cent of all global GDP. Another estimate two months later projected $23 trillion in annual economic value by 2040, from AI software and services alone, and noted that the entire United States gross domestic product (GDP) in 2024 was approximately $28 trillion.[5]

By late 2024, 35 per cent of businesses had adopted AI technologies in their operations, and another 42 per cent were considering AI for future implementation. AI is being used by more than 50 per cent of large companies with over 5,000 employees. More than 90 per cent of government organizations surveyed globally are already using or exploring using AI. The kinds of AI use cases these businesses and Governments are developing, for example, revolutionizing healthcare by expanding access to quality services and enabling unprecedented new forms of treatment and disease prevention as well as optimizing energy usage and integrating renewable energy sources into power grids; and much more. The United Nations has documented more than 400 AI projects globally in support of the SDGs. They are, for example, optimizing crop yields while minimizing resource consumption in sustainable agriculture initiatives and revolutionizing climate modelling and climate change impact mitigation strategies. New avenues for employment, learning, connectivity and personal fulfilment are being opened up for people around the world.[6]

AI is not just a tool to be leveraged, but a force to be reckoned with. From the largest public and private sector institutions to enterprises and countries with modest resources, to individuals in their everyday lives, no one can ignore AI. While the costs of embracing AI are high in some respects, it has a lower entry barrier than other technologies, making it possible for all organizations and societies to engage in seizing the opportunities that AI enables.

A. With great opportunities come great challenges

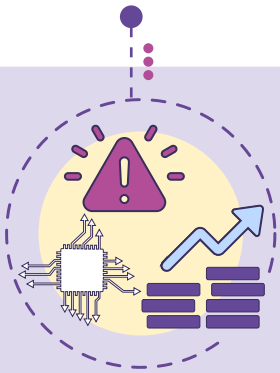
Against the incredible societal benefits introduced above, leaders must juxtapose existing challenges and risks, which will accelerate and scale as AI does. One risk is the impact that biases in AI algorithms and models present as these models are used for decision-making in organizations on an ever-widening range of topics and issues. Because they generate results based on the data on which they are trained, their results unavoidably reflect the culture from which the data are drawn, which has been shown to favour certain groups in the models' predictions. For example, the AI underlying Google displays far fewer ads for high-paying executive jobs to women users. In law enforcement, "AI-powered predictive policing tools … can reinforce patterns of racial profiling and disproportionate targeting of minority communities".[7]

Another set of challenges has to do with intentional use of AI for criminal or other nefarious purposes. This includes the generation of deepfakes – video, audio and other forms of misrepresentation of actions and behaviours. As a recent analysis from the Brookings Institution notes, "because they are so realistic, deepfakes can scramble our understanding of truth in multiple ways",[8] with potentially high degrees of harm. Another risk is the introduction of spurious data with the deliberate intent of deceiving AI models – a phenomenon that has been dubbed AI pollution.

Because AI is fuelled by data, there are natural risks associated with how and to whom that data are made available. Data protection risks associated with AI include data breaches due to the vast amount of sensitive data processed, and privacy

concerns from models and applications collecting personal information without consent. Potential criminal and other misuses are enabled by the fact that peoples' and organizations' data are widely available to AI models and applications. Given the increasingly anthropomorphic nature of AI applications (e.g., chatbots, realistic virtual reality (VR) agents), there is a risk factor of "people becoming more likely to develop trusting relationships with AI … and consequently more inclined to share increasingly personal information".[9]

Some core aspects of AI have a dual benefit-risk edge. For example, one use of AI widely considered to be beneficial is in surveillance systems. AI algorithms can autonomously analyse and synthesize video and other forms of data to identify people, vehicles, objects and behaviours in real-time for better and faster detection of security threats. At the same time, many have concerns about the same AI applications being misused by Governments or other actors for surveillance to enact repressive measures.[10] Another dual edge benefit-risk consideration relates to the growing ability of AI to provide decision-making support. This is already driving transformational beneficial effects in nearly every business sector and aspect of life. At the same time, there are already growing concerns that this ceding of control is making users lazy, with risk implications as AI is used more widely for decision-making support on increasingly more important topics and issues. Some developers of current market-dominating AI models have voiced concerns about the future of human agency over AI. There are questions as to whether AI will become superintelligent, a so-called "artificial general intelligence that can match or exceed human-level performance", and even potentially advance to some form of sentience that could be beyond human control.[11]



Most projections for the decade from 2030 to 2040 show exponential **increases** in what the world has seen to date in **investment**, range of use cases, **pervasiveness**, **threats** and other aspects of the AI phenomenon.

B. Today's moment will not last

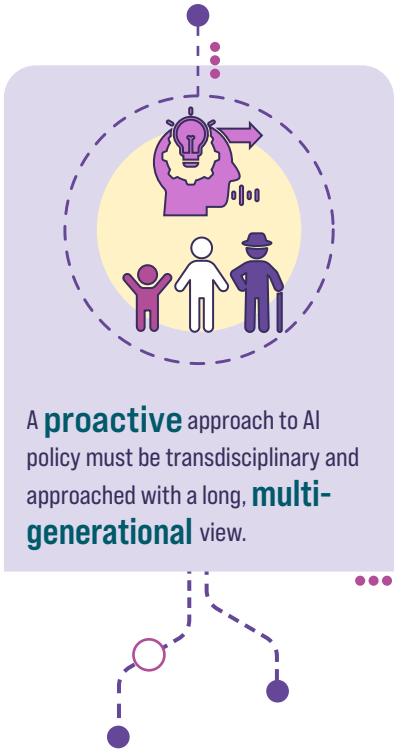
AI will continue to accelerate and scale in ways so that, in five years' time, its current capacities will seem modest. Most projections for the decade from 2030 to 2040 show exponential increases in what the world has seen to date in investment, range of use cases, pervasiveness, threats and other aspects of the AI phenomenon. Underlying the pace of increase is the pace of advancement of the technology itself. In late 2023, in testimony before the United States Senate, the chief executive officer of AI company Anthropic said that "the single most important thing to understand about AI is how fast it is moving".[12] The rate at which humans are being surpassed by AI in accomplishing new tasks has increased dramatically over the last decade. The amount of computing power used to train AI systems climbed slowly for 60 years until 2010, and since then has skyrocketed year over year. The same is true of the number of data points used to train AI models.[13]

The release in January 2025 of a new LLM from Chinese company DeepSeek is emblematic of the pace of advancement of AI. It stunned many observers by training the model in substantially less time, with fewer and less powerful chips, at substantially less cost to develop than those of its global competitors. Two days later, a White House press conference announced "the largest AI infrastructure project by far in history" – a new $500 billion collaboration (Project Stargate) between United States-based OpenAI, Oracle, Japanese investment company SoftBank and United Arab Emirates government-backed tech company MGX.[14]

This speed of the advancement of AI is why it is critical for leaders to contend with both sides of the opportunity and risk equation – thoughtfully, rigorously and

creatively. The phenomenon of AI creates an imperative for strategic foresight, and strategic foresight requires using insights into what we can anticipate regarding tomorrow to identify decisions and actions leaders can take today to prepare for and succeed in the future.

There is a long history of technological innovation racing far faster than Governments. There is limited ability to put policies and regulations in place to effectively promote the equitable deployment of new technologies and manage the risks. For a range of reasons, Governments evolve incrementally, while technology increasingly demonstrates "combinatorial innovation".[15] Advances in individual technologies are combined to create effects far greater than the advances possible from any one individually. If leaders today take traditional approaches to reacting to innovations and resultant changes, the promise of AI will not be realized, and the risks of its potential harms may be great. Leaders must anticipate and pre-adapt to them instead.



A **proactive** approach to AI policy must be transdisciplinary and approached with a long, **multi-generational** view.

A proactive approach to AI policy must be transdisciplinary and approached with a long, multi-generational view. As founder and executive director of Data Economy Policy Hub, Shamira Ahmed, notes, "AI impacts economics, ethics, law, science, sociology, and even the environment [in] complex, interconnected [ways that] cannot be fully addressed from any single disciplinary perspective".[16] Leaders must start working today to develop "anticipatory AI policies that reflect the complexities of our interdependent global society, support responsible innovation, and create inclusive intergenerational benefits". It is essential to seize this opportunity now, when the impact of public policy actions taken early can shape the future. Leaders that wait are likely to find little room for policy manoeuvre later, after the route AI can take has already been charted and set.[17]

C. Aim and approach of this report – exploring alternative pathways for the future advancement of AI in the Arab region

This report and the research underlying it explore the potential for region-centric approaches to the public policy dimension of AI. The intention is to help leaders in the Arab region optimize the positive impacts and minimize the negative impacts of this technology megatrend on the Arab region. It recognizes that leaders everywhere in the world have sometimes been ill-prepared for past megatrends due to insufficient advanced consideration of them. The aim is to provide leaders in the Arab region with extensive current considerations of some of the potential futures of the AI megatrend, while the technology is still gaining momentum. This can help ensure preparation that is not only sufficient but optimal for the countries and people of the region.

The report examines three alternative pathways that AI could take in the Arab region over the next 10 to 20 years. Each represents a direction that the advancement of AI might take in the region that could gain magnitude and momentum through deliberate strategies with supportive policy and other actions to achieve distinctive aims. The pathways are not mutually exclusive. They can proceed in parallel to varying degrees, and there can be degrees of overlap and complementarity between them.

The first pathway (chapter 2) explores how countries in the region could pursue strategies for adapting AI developments sourced from anywhere in the world in ways

that serve and advance distinctive local priorities that may be key elements of their national vision.

The second pathway (chapter 3) explores how countries in the Arab region could pursue strategies for using LLMs trained on Arabic language data and culture to fuel the growth of their economies. It also looks at using AI to preserve, restore and promote the Arab region's cultural heritage.

The third pathway (chapter 4) explores how countries in the Arab region could pursue strategies that select and then scale AI applications to accelerate their attainment of the SDGs, particularly in countries where SDG progress is most urgently needed.

D. Underlying any pathway: capacity-building

These are not the only pathways countries in the Arab region could pursue to leverage AI in their future societies. Whether these pathways or others are pursued, building the capacity to develop and use AI will be essential. Capacity-building is imperative for every country globally. Critical decisions for public, private and civil sector leaders will be how to do so in the most appropriate ways given the conditions and starting points unique to each country. A number of elements comprise the capacity-building imperative for countries in the Arab region.

One is creating an appropriately trained and skilled workforce. Skill development for living and working with information and communication technologies (ICT) in the digital economy is already underway in every country in the Arab region, though the level and pace varies significantly. Working in and with AI demands new additional specific skills and abilities, such as in developing and training algorithms and using machine learning to automate tasks. Because the pace of advancement for AI is so fast, and is expected become even faster, capacity-building in terms of skill development will need to be continuous and lifelong.

A second essential element of capacity is AI-relevant infrastructure. As with skill development, in the Arab region and elsewhere there is a foundation of such infrastructure for the broader digital economy and society, and also AI-specific infrastructure needs. The former comprises 5G mobile and other types of communications networks for Internet connectivity, cloud platforms and cybersecurity systems. Beyond these, countries and industries will also need new types of infrastructure that are uniquely demanded by AI.

A third element is institutional capacity – the mechanisms for overseeing and governing the development and use of AI within countries as well as across borders. Similarly to skill development and infrastructure development, there is already a foundation. Numerous countries have agencies or sub-agencies, created within the last decade, dedicated to fostering and regulating the digital economy. Many of these institutions can have their scope expanded to encompass AI, and some are already being retrofitted. At the same time, it is recognized that, because so much about AI is novel, adapting existing institutions may be insufficient, or could even be counterproductive and create risk. Newly created AI-specific institutions are already beginning to appear, for example the Spanish Agency for the Supervision of Artificial Intelligence. Considerable additional attention is needed for conceptualizing and creating the institutions that countries around the world will need for the futures of AI.[18]

Chapter 5 of this report explores a range of considerations and issues related to the capacity-building necessary in the Arab region to pursue any pathway for AI development and usage. That chapter includes issues related to jobs and AI in the Arab region.

E. Key findings, key messages and recommendations

Chapter 6 of this report draws from all the prior chapters. It compiles policy and other recommendations from chapters 2 through 5. It also provides key findings and key messages for each recommendation.

Key findings are factual points revealed by the research underlying this report, highlighting a notable reason why the recommendation is needed. Source citations for the key findings are included in the report text where these factual points first appear and are not repeated in chapter 6.

Key messages relate to the importance and relevance for the region of that finding and its accompanying recommendation. It answers the question of why the finding is important for the Arab region and further contextualizes the recommendation. The recommendations represent actions public policymakers and other-sector leaders can take now and in the near future to address the finding and its key message, in the context of the overall AI megatrend.

2

alfa27/via adobe stock

Pathway 1: Optimizing diverse AI technologies and partnerships for local priorities

A. Think globally, impact locally

Since 2022, AI is being adopted more rapidly and globally than other major technology phenomena, including mobile phones or the Internet. With each passing month and year, more countries, including nearly every country in the Arab region, are developing AI capabilities or accelerating current development of AI. The recent sudden spike in AI development was initially primarily concentrated in the more industrially developed world, and some countries are emerging as clear leaders in the AI race, enabled by their considerable financial and other resources. At the same time, commensurate with their resources, many other countries including in the Global South also are pressing forward with AI development at a pace comparable to those leaders.[19]

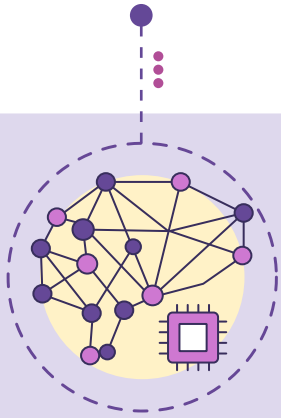
This is occurring due to a global recognition that the aggregation of technological innovations that comprises AI today enables previously unachievable advancements in economies and social innovations. Every country can see how it can deliver breakthroughs on many of their national priorities, with leaders in every sector throughout the world eager to move AI agendas forward. The burgeoning number of ways that AI can be applied to a plethora of objectives enables these leaders to tailor their AI investments to what is distinctively important to their societies.

A growing number of countries today are embarking on strategies for what has been described as "sovereign AI".[20] This is a matter of domestically developing their own AI foundational and language models and other AI research and development capabilities and infrastructure. Locally curated and controlled datasets, a native AI-skilled workforce, governance frameworks, and other elements are also part of this equation. But a focus on making the technology locally is not the only way countries might think about developing AI to advance their sovereign interests. Some may take an approach of selectively developing some elements of their AI tech stack

indigenously, while in parallel building collaborations with global partners to adapt AI technical innovations developed elsewhere for some of the objectives they want to achieve. Creating governance and other mechanisms to ensure local authority over the fruits of such partnerships is critical.

For some countries in the Arab region, the latter may be an optimal pathway. The version of the sovereign AI concept emerging as dominant today, emphasizing self-reliance in model and infrastructure development, has benefits but also risks. One risk is that the cost and other burdens of large-scale indigenous AI research and development and infrastructure development could divert limited resources from other vital pursuits. Another risk is that countries could, if they determine self-reliance to be unrealizable, see other forms of strategic investment in AI as impractical as well, leaving them lagging behind on a megatrend that will shape every society and economy. These risks exist for middle- and lower-income countries anywhere in the world, not just those in the Arab region, as well as for wealthy countries.

Combining indigenous development with adapting external developments through partnerships is an AI pathway for countries in the Arab region. It prioritizes impact, customized to local needs, over efforts to secure a place in what is emerging as a sovereign competition that is global in scope. Rather than aiming to replicate others, countries in the Arab region can work to be leaders in applying AI to their own distinctive priorities, optimizing research and development innovations from any source in service to those priorities.



The amount of computing power used to train **AI systems** doubled every 20 months from the 1950s to 2010, and since then has doubled every six months. The number of large-scale AI models released went from 9 in 2021 to 29 in 2022 to **more than 100 in 2023**. The cumulative number of large-scale AI models released by developers in the top ten countries (all wealthy and industrialized) climbed **from 47 in 2022 to 282 in 2024.**

B. Global AI development efforts indicate that one size need not fit all

Recognition of the transformational potential of AI is fuelling research and development and investment worldwide. The amount of computing power used to train AI systems doubled every 20 months from the 1950s to 2010, and since then has doubled every six months. The number of large-scale AI models released went from 9 in 2021 to 29 in 2022 to more than 100 in 2023. The cumulative number of large-scale AI models released by developers in the top ten countries (all wealthy and industrialized) climbed from 47 in 2022 to 282 in 2024.[21]

1. AI development is increasingly global...

The 10 countries that produced these large-scale models are far from the only ones investing in and developing AI. Activity is also considerable in countries whose means for developing AI are more constrained. In September 2024, The Global AI Index documented AI development activity in 83 countries around the world, spanning every region. The index ranks these countries based on a calculus involving 122 indicators grouped in the categories of innovation (level of and output from research and development), implementation (comprising availability of AI-trained talent, reliability and scale of infrastructure, and the nature of the regulatory and public opinion environments), and investment (both government and commercial).[22]

The data show the truly global nature of the AI phenomenon – the list of 83 countries is notable for its geographic

scope, and they are not the only countries developing and leveraging AI. The data also show how the intensity of some countries' efforts to develop and apply AI is not necessarily correlated to their income. It is also evident that a focus on indigenous model and infrastructure development is not the only or most important determinant of success for every country in gaining the transformative economic, social and other potential outcomes of AI.

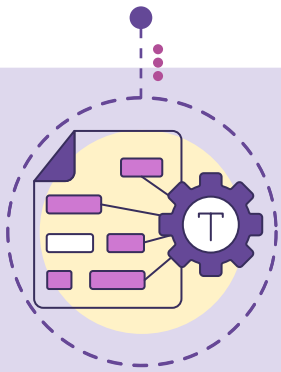
As noted, there are clear leaders in global AI development. Given their economic resources, the United States and China each are markedly more advanced than any other country. A cluster of eight advanced industrialized economies are at the next level of development, essentially equivalent with one another. A third tier of 20 other countries are also effectively equivalent to one another, and there is a fourth tier comprising the remainder of the 83 countries. Two Arab region countries – Saudi Arabia and the United Arab Emirates – fall in the third tier, while eight others fall in the fourth tier. Another index which ranks countries' AI development employs its own set of indicators.[23] Overall, it mirrors the findings of the Global AI index closely, although it ranks a few individual countries slightly differently.

2. … but countries are emphasizing different things in shaping their AI futures

Numerous elements comprise a national approach to developing and leveraging AI. These range beyond local model and infrastructure development, to things like adaptation of open-source models, diversity of a country's AI workforce, number and quality of education institutions teaching about AI, patents for AI applications, responsible AI efforts (ethical and values-based research and development and use frameworks) and legislative activity. Looking at some individual countries shows the benefits of national AI strategies that emphasize these other kinds of metrics, and that mix some local research and development with adapting and leveraging externally-developed models and infrastructure.[24]

For example, South Korea, sixth overall in the Global AI Index, has prioritized development of platforms and algorithms to power AI tools and projects more than fundamental AI research. Singapore has also prioritized local development and local research, ranking fifth and third in those indicators. Neither country has invested proportionally in rooting their AI


THANANIT/via adobe stock



Of the top 25 AI intensity countries, 10 have GDPs of **$500 billion** or less, and 3 of **$100 billion** or less. Luxembourg ranks only 16th in research and 24th in development, but third in overall intensity due to its investment in other elements of its AI future. Estonia ranks even lower in **local research** (34th) and **development** (52nd) but 17th in overall intensity, thanks to its emphasis on fostering **startups** in local commercial **AI businesses.**

development efforts in a local regulatory environment or a public dialogue about AI, two elements that will be important to tie those developments to national or citizen priorities. India has placed significant emphasis on the development of platforms and algorithms to power AI tools and projects and on local AI talent development (second only behind the United States on that indicator), while ranking near the bottom of the index on investment in locally-developed infrastructure needed for AI applications.[25]

The intensity metric (AI capacity relative to the size of a country's population or economy) also illustrates that research and development on LLMs and infrastructure need not be predominantly indigenous for a country to excel in using AI to create positive impacts on local priorities. Intensity requires putting available resources to work in whatever ways make the most sense and create the greatest impact for a country. Of the top 25 AI intensity countries, 10 have GDPs of $500 billion or less, and 3 of $100 billion or less. Luxembourg ranks only 16th in research and 24th in development, but third in overall intensity due to its investment in other elements of its AI future. Estonia ranks even lower in local research (34th) and development (52nd) but 17th in overall intensity, thanks to its emphasis on fostering startups in local commercial AI businesses. Switzerland ranks fifth, in part from focusing more on developing local AI workforce talent than on local models and algorithms. Sweden, Portugal and Belgium are thriving in AI by focusing on regulation and public trust, despite their local AI research and development and infrastructure development being in the mid to lower ranks. AI intensity produces results, but there is no single formula for intensity.[26]

C. Adapting and partnering – an AI pathway for impact in the Arab region

The countries in the Arab region farthest along in development and application of AI already benefit from collaborations with global partners. Through collaborations they are working to adapt those partners' AI innovations to boost their research and development and infrastructure self-reliance. Other countries in the region, at an earlier stage in creating their AI future with the resources they have, are also forging global partnerships and may benefit even more. The foundational and language models and infrastructure needed to optimize technology's impact on the distinctive priorities of each country may be developed locally, but they need not necessarily be – they may be more efficiently and effectively adapted from innovations developed elsewhere.

1. The power of the technology may be more important than power over it or from it

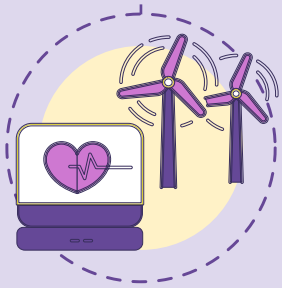
Since the term was publicly coined, the narrative of sovereign AI[27] has been framed more as one of local self-reliance in developing the technology than of local benefits from applying it. The reality is that only a very few initiatives underway globally that are termed sovereign AI actually reflect the self-reliance that the narrative implies – "a counterintuitive commonality among sovereign AI model projects is that they are generally open source [not a] closed approach to maintain control over how it is built and distributed".[28] While many employ supercomputers developed by their national Governments, most are reliant on other technology from United States or other non-

local sources. Advanced microchips represent the greatest foreign dependency for all sovereign AI efforts, and controls over access to these chips are anticipated to be an enduring structural barrier to AI self-reliance. From the United States, the Regulatory Framework for the Responsible Diffusion of Advanced Artificial Intelligence Technology announced in January 2025 is only the most recent such mechanism. Other countries, including Taiwan, Japan and the Netherlands, have their own controls in place on key elements of the semiconductor supply chain.

Beyond the potentially unrealizable idea of infrastructure and research and development self-reliance, much of the sovereign AI concept aligns with the idea of adapting and partnering. Other pillars are a local AI-skilled workforce; regulatory and ethics frameworks customized to the values and cultures of each society; creating a conducive environment for homegrown AI-driven businesses and public sector applications; and international cooperation.

Most elaborations of the concept focus on all these elements and on locally generated and controlled data in the local language to train AI models (wherever the models may have been developed), as "the most commonly stated objective of sovereign LLM projects is protecting and promoting national languages, threatened by the potential dominance of LLMs trained primarily on the English language".[29]

Adapting models and infrastructure developed externally, and partnering with companies and Governments outside the region, can help countries in the Arab region to build each of these pillars, potentially even more rapidly and effectively than efforts to build them locally. Partnerships can help train and educate local workforces for future jobs developing and using AI, help foster local AI startup ecosystems, and help develop sound AI governance frameworks. Countries can take actions in the near-term to build partnership efforts for long-term impact.



The work with Huawei is contributing to the development of **Arabic language** LLMs, while the work with IBM focuses on adapting AI to **healthcare** and **energy** sector use cases. Additional partnerships have followed, including deals that secured nearly **$1 billion** in funding **in 2022** for over 40 AI and other tech startups; an Aramco Digital strategic partnership with privately-held United States tech services firm World Wide Technology; and a major Saudi public investment fund venture to adapt Google's AI offerings and jointly invest in AI skill development for the local workforce.

D. Partnering to adapt AI for local needs is taking off in the Arab region

Examples of Arab region countries collaborating to adapt AI to local needs and priorities are already being seen and can be anticipated to increase both in number and impact.

1. Burgeoning partnerships between Governments and private sector entities in the Arab region with counterparts around the world to adapt AI to local needs and priorities

Saudi Arabia has entered into major collaboration commitments over the past several years on AI to drive its future economy and society. In three separate agreements in 2020, the Saudi Authority for Data and Artificial Intelligence joined with IBM and the Chinese companies Alibaba and Huawei. The partnership with Alibaba focuses on adapting the company's algorithms to advance a specific Saudi Vision 2030 goal of enabling new levels of smart city functionality across Saudi Arabia. The work with Huawei is contributing to the development of Arabic language LLMs, while the work with IBM focuses on adapting AI to healthcare and energy sector use cases. Additional partnerships have followed, including deals that secured nearly $1 billion in funding in 2022 for over 40 AI and other tech startups; an Aramco Digital strategic partnership with privately-held United States tech services firm World Wide Technology; and a major Saudi public investment fund venture to adapt Google's AI offerings and jointly invest in AI skill development for the local workforce.[30]

International partnering to develop and adapt AI has also been a major focus in the United Arab Emirates over the past several years. The Telecommunications and Digital Government Regulatory Authority adapted ChatGPT in 2023 to create the U-Ask chatbot, enabling queries in more than 50 languages to transform how Emirati citizens and other users engage with the Government. A major collaborative venture was announced in April 2024 between Microsoft and G42, the AI company partly owned by Abu Dhabi sovereign wealth fund Mubadala. Microsoft's investment – the largest private investment globally made to any AI company in 2024 – "will support a new $1 billion developer fund to create an AI workforce and talent pool to drive innovation across the region", not just in the United Arab Emirates. Projects supported by the developer fund will be creating and adapting AI applications to priorities across multiple sectors of the United Arab Emirates economy and society with access to Microsoft's computing resources leveraging export-controlled Nvidia chips.[31,32]

Ongoing talks between Mubadala, Taiwan Semiconductor Manufacturing Company and Samsung Electronics point to a similarly significant emerging partnership. This and other international partnering efforts represent steps by the United Arab Emirates to meet the country's International Artificial Intelligence Policy. The policy codifies a national aim to "establish international alliances for developing, securing, and governing AI systems". It also elaborates the Government's intent to agree with partners on "transparency and built-in checkpoints within AI tools to enforce ethical standards and accountability measures".[33]

Other Gulf Cooperation Council (GCC) countries are pursuing partnerships to adapt global AI innovations to meet their local priorities. A growing number of the 170 companies in financial technology (fintech) in Bahrain are from outside the region, operating in a regulatory sandbox intended to offer them a conducive environment for AI-driven applications and business model experimentation. In Oman, a partnership was recently announced between Nokia and local tech company Ooredoo to deploy a state-of-the-art network to meet the considerable connectivity needs of local data centres, AI-driven applications and cloud-based platforms. Oman also will host a new Center for the Fourth Industrial Revolution to develop and adapt AI with global partners. Three companies in the Arab region – Riyadh-based Intech Smart Buildings, Qatar-based facilities management firm Fixit and Dubai-based Smart Energy Savings – are partnering with United Kingdom-based Arloid Automation on adaptations of AI to reduce the energy requirements associated with their own operations and in AI-based smart facility applications their clients use.[34,35]

Egypt also offers examples of taking steps along a pathway of partnering and adapting AI to its national priorities. In April 2024, Egypt established an agreement with Italy for a joint centre for collaboration between research institutions and businesses to develop AI applications and workforce AI skills in Egypt and elsewhere in Africa. Since late 2024, Egypt has also worked with Latvia on creating similar centres to collaborate on AI adaptation and workforce development; with the United States and Japan to adapt AI applications in the healthcare sector; and with Chinese State-owned Tsinghua Unigroup Co. Ltd. for a $300 million investment fund for AI.[36]

Morocco has established partnerships under its Digital 2025 strategy with Huawei, IBM and Google and with academic research institutions abroad. It is also looking to South-South cooperation, particularly with other African nations, to advance its aims in the regional and larger global AI ecosystem. Tunisia has opened a new AI innovation hub called Novation City. Jordan has global partnerships dating back to 2002 for developing and adapting AI locally, for example with the Japanese International Cooperation Agency, and with the United States Trade and Development Agency on AI for cancer research with King Hussein Cancer Foundation.[37]

2. Intra-regional and cross-sector collaborations help adapt AI for Arab region countries' priorities

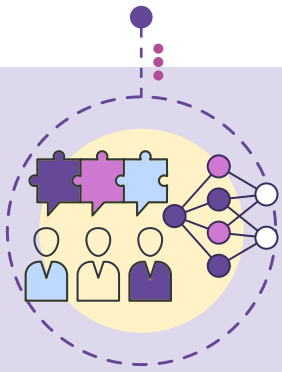
Many of the AI-related partnerships countries in the Arab region have formed or are forming are with the United States and Europe, and to a lesser extent with China and other Asian countries. Intra-regional collaborations are also being formed to serve each regional partner's local priorities.

In January 2025, Morocco and Saudi Arabia met to discuss potential commitments and means to collaborate on AI development and applications to drive socioeconomic development in both countries. Morocco has already advanced beyond exploratory dialogues to an agreement with A171, the AI company launched by the Abu Dhabi Advanced Technology Research Council and its commercialization arm VentureOne. The deal will help Morocco leverage A171's open-source Falcon AI models to "adapt AI solutions to enhance citizens' access to government services", an important objective of the Digital Morocco 2030 strategy. It will also help Moroccan startups access computing power they can use to develop AI applications that align with local priorities.[38]

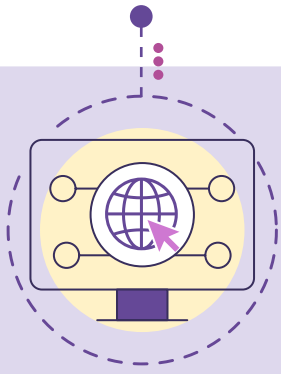
Egypt and the United Arab Emirates have also been moving forward with AI collaborations, including a framework memorandum of understanding signed in December 2023 for joint investments in data centres for AI in Egypt. Another collaboration being explored involves bringing educational institutions in the two countries together for AI skill development. Officials from Egypt and Algeria met in June 2023 to map out initiatives (data centres, new undersea cables for broadband connectivity) to enable and adapt AI to serve priorities in both countries. A recent study assessed the benefits of Algeria, Libya, Mauritania, Morocco and Tunisia working together in AI, recommending initiatives to share AI knowledge and expertise, joint investments in AI education and technology infrastructure to develop AI capabilities, and work on AI adaptations to improve efficiency and productivity across sectors.[39]

Several intra-regional forums are bringing countries in the Arab region together to engage at a policy level on actions they can take in alignment with one another to use and adapt AI for shared and individual countries' priorities. One is the technical committee on AI and new work patterns established at the annual Arab Labour Conference in September 2022 and continuing in 2024 to establish collaborative actions to take advantage of AI and address the challenges it poses. Another is the Arab Working Group on Artificial Intelligence, formed by the Arab Council of Ministers for Communications and Information (ATICM) at their annual meeting in 2019. One aim is to "develop a unified Arab strategy, adopt regulatory frameworks for leveraging AI, and come up with guidance for ATICM member states on the best ways to employ these frameworks to serve the goals of the Arab countries".[40]

Countries in the region are also collaborating with one another in cross-sector AI-focused forums with the United Nations



Countries in the region are also **collaborating** with one another in cross-sector **AI-focused** forums with the United Nations and other intergovernmental organizations.



In 2011, there were fewer than **900 AI-related** projects on GitHub, a proprietary web-based platform that allows developers to store, manage, and share code. **In 2023**, there were approximately **1.8 million** projects, a **59 per cent** rise that year alone over **2022**.

and other intergovernmental organizations. In February 2024, the United Nations Development Programme joined with Mohamed bin Zayed University of Artificial Intelligence to co-lead a new AI for Sustainable Development Platform, AI4SDP. AI4SDP will facilitate partnering efforts to adapt AI innovations developed anywhere in the world to help countries meet SDG targets. Nineteen Arab countries joined together with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and other countries in May 2024 in an initiative to promote the adaptation of AI tools and frameworks for integration into national education systems. In the same year, the Saudi Data and Artificial Intelligence Authority joined with the Organisation for Economic Co-operation and Development (OECD) to adapt the latter's framework for AI incident monitoring to language models and other AI tools developed in the Arabic language.[41]

3. Strategic use of open-source software and algorithms will be an increasingly powerful means of partnering to adapt global AI innovations to Arab region countries' priorities

Open-source development of AI models could be characterized as at the other end of the spectrum from sovereign AI. It is the most expansive way countries in the Arab region can pursue a pathway of partnering on AI for local priorities. Going beyond discrete, structured, negotiated partnerships, open source is a means for working in real time with a global community of developer partners that numbers in the millions. These developers are continuously adapting the work of other partners and making their own work available for adapting. The open-source community and mentality is democratizing AI, whereas closed-source models only allow those with access to larger computing infrastructures to develop the technology. In countries with limited resources, open source will be vital to enabling them to adapt AI in ways that suit their distinctive aims.[42]

Open-source AI research has grown exponentially over the last several years, in tandem with the post-ChatGPT boom. In 2011, there were fewer than 900 AI-related projects on GitHub, a proprietary web-based platform that allows developers to store, manage, and share code. In 2023, there were approximately 1.8 million projects, a 59 per cent rise that year alone over 2022. More than 80 per cent of companies are building 25 per cent or more of their AI tools on open-source platforms, and thousands of software development teams globally have experimented with open-source AI. In 2023, nearly two thirds of the AI foundation models released were open source. GitHub is far from the only repository and partnering ground for open-source AI. Others include Hugging Face, Data Version Control and DagsHub. The Hugging Face platform alone is home to more than 900,000 models, 200,000 datasets, and 300,000 demo apps. Developer communities formed around niche areas within AI and machine learning are other platforms for open-source collaborators. Major tech and cloud companies offer open-source tools on their platforms, like the Google AI Model Garden and Amazon CodeWhisperer. A growing number of research institutions host the open-source models of their researchers.[43]

Adaptation of AI through open-source partnering is one key to the strides countries in the Arab region have made over the past several years, and it will be key to their continued advancement. The most prominent and capable Arabic language models in the world have been built through such collaborations. Some have been adapted from existing open-source models. Others have been custom built then made open for developers anywhere in the world to adapt for distinctive needs.

The United Arab Emirates and Saudi Arabia saw the **highest increase** in **talent migration** **in 2023** (1.4 per cent and 1.3 per cent, respectively), and nearly one in three AI experts that moved **in 2023**, moved to the Middle East.

4. Bringing Arab region diaspora experts into structured collaborations in their countries of origin could be a resourceful way to adapt AI innovations to local priorities

Another approach to partnering to adapt AI to priorities and contexts of the Arab region could leverage researchers, developers and entrepreneurs living in diaspora. Migration from many countries of the Arab region is a long-recognized trend. A local tech and AI sector is showing signs of growth and could possibly counter the loss of this homegrown tech talent. The United Arab Emirates and Saudi Arabia saw the highest increase in talent migration in 2023 (1.4 per cent and 1.3 per cent, respectively), and nearly one in three AI experts that moved in 2023, moved to the Middle East.[44]

However promising this trend, the number of skilled Arab region technical researchers and developers living abroad is considerable. Strategies can tap into these experts to help adapt AI to priorities in their countries of origin. Mauritania recently created a self-described academic diaspora platform called MARAM to enable AI-focused Mauritanian researchers working abroad to support the implementation of the national AI strategy. Another example is the Tunisian AI Society. It was created as a community of expatriate academics, tech sector workers in AI, researchers, and others to collaborate with organizations and initiatives and participate in making Tunisia a tech hub in AI in the region.[45]

5. Governance frameworks will be critical in ensuring that partnering and adapting aligns with countries' values and cultures as well as with specific priorities

Legal and regulatory constructs for local authority over the development, deployment and use of AI are acknowledged as an essential pillar of sovereign AI. Whether the technology is developed locally or adapted from external partners, such constructs help ensure that AI is controlled and regulated within a specific nation to ensure alignment with its unique values, laws and strategic interests. As legal and regulatory constructs are created and implemented, they will provide clear guidelines for AI development and deployment, regardless of the source of the technology, and mechanisms for oversight and accountability, ensuring that AI technologies are used responsibly and benefit society. Recognition of the importance of AI governance mechanisms and agreements, within countries' borders and across borders, is demonstrated by the large number of legislative and regulatory actions that have been taken or proposed globally.[46]

For countries emphasizing external partnerships as a core element of how they adapt AI to their local priorities, legal and regulatory frameworks will be particularly important to ensure that the fruits of such partnerships align with local laws, values and contexts, and that partners welcome being accountable to what these frameworks require. There are clear indicators in their existing and emerging AI plans that countries in the Arab region are building the foundations of frameworks that will serve them well as they create their AI futures, should they choose to pursue the prospective pathway this chapter describes, or any pathway.

The Arab region is notable for such work. At least **15 ESCWA member States** have national visions or were developing one **in 2024**. The majority of countries in the Arab region have adopted the **2030 Agenda** for Sustainable Development in these national visions.

E. Many countries have long-term national visions they are pursuing, offering opportunities to adapt AI to established plans for the future

Many countries have developed national visions with goals and objectives for their long-term future, often over timespans of ten to sometimes thirty years. At least 15 countries in the Arab region have national visions. They represent a framework for linking their partnering and other efforts to adapt AI to clearly defined goals on which leaders and populations are aligned.

1. Countries in the Arab region have long been focused on the long-term

A 2014 analysis showcased 16 countries that at that time had created long-term visions and the benefits gained from them. If terms other than national vision document are considered, such as national development plan or strategic vision, the number of countries that have structured plans at the national level regarding their long-term future is considerably higher.[47]

The Arab region is notable for such work. At least 15 ESCWA member States have national visions or were developing one in 2024. The majority of countries in the Arab region have adopted the 2030 Agenda for Sustainable Development in these national visions. Saudi Vision 2030 may be among the most well-known. Its three pillars of a vibrant society, a thriving economy and an ambitious nation have specific associated goals and objectives. Implementation is moving forward in vision realization programmes, including initiatives in health sector transformation, industrial development and human capability development. Vision 2030 is foundational to how the Saudi Arabia is creating its future.[48]

Other countries in the region have similar long-term plans. For example, the 2030 Vision of Egypt, published in 2023, describes six strategic goals. These include improving Egyptians' quality of life and raising their living standards; creating an integrated and sustainable environmental system; and building a diversified, knowledge-based and competitive economy. For each strategic goal, the country's leaders identified several general goals and a number of specific means of attaining them. Jordan has its Vision 2025, promulgated in 2015, built on three core objectives: boost economic growth, achieve fiscal stability, and provide support to those who need it; enhance the business and investment environment and raise its competitiveness; and hone the tools and means to develop and support priority economic sectors. The vision lays out a series of specific goals and objectives for transforming the country's model of development, with initiatives focused on key existing, emerging and high-potential clusters of industries for growth. In early 2019, Iraq promulgated its Vision 2030 with 25 goals across five national priorities.[49,50]

Since 2017, many countries have begun to craft and adopt national AI strategies. At the end of 2023, an estimated 75 countries had a national AI strategy. Bahrain and Iraq were among eight countries that released their strategies during 2023. More than half the ESCWA member States have national AI strategies, and others are developing strategies or other national-level AI frameworks or guidance. At the release in 2024 of the OECD Principles on Artificial Intelligence, officials reported "significant policy attention and action evidenced by more than 1,000 AI initiatives

in over 70 countries and jurisdictions".[51] Almost half of these are public-sector-driven (244 initiatives at the national government level, 88 at the sub-national government level, and 135 by public research institutions). The national AI strategies in a number of countries around the world are tied specifically to societal challenges or priorities identified by those countries, including (in descending order of number of initiatives in these areas) inclusiveness, health, environmental sustainability, climate change, energy security, food security and aging populations, and a general category that includes transportation, economic development, sustainable development, entrepreneurship and other priorities.

Countries in the Arab region can forge a pathway that explicitly links what they prioritize in their partnering on and adaptations of AI to goals and priorities in their national vision or similar country-level policies and documents. They can consider how current goals, priorities and objectives in their national visions can be advanced by AI in ways that were never previously possible. As the technology and their adaptations of it continue to advance, they can consider what new goals, priorities and objectives might be added to their visions that can be advanced by AI to enable societal wellbeing.

Annex 1 provides examples of how AI can be used – and is already being used – to advance objectives in three sectors that are prominent in many Arab region countries' national visions: transportation, water resource management and energy. The examples in the annex are not a prescription for which national vision priorities countries should select to employ AI on, or for specific applications of AI in these sectors. They are intended only to inspire thinking in about ways in which AI can be adapted in support of whatever national vision or other priorities countries assess to be of particular value.

F. Recommendations aligned with this pathway

Four recommendations align with the pathway for AI development in the Arab region outlined in this chapter. They are not exclusive in their relevance to this pathway, as they could also be supportive of other pathways that policymakers and other leaders might pursue.

Draft, adopt, and implement an Arab Region Charter for Responsible AI as a foundation for ethics, safety and security both in local development of AI and in adaptations of partners' AI innovations and in the use of AI applications from any source

Responsible AI refers to "the design, development, deployment, and governance of AI in a way that respects and protects all human rights and upholds the principles of AI ethics through every stage of the AI lifecycle and value chain. It requires all actors in the national AI ecosystem to take responsibility for the human, social and environmental impacts of their decisions".[52] The concept and principles of responsible AI are becoming increasingly widespread in Governments' and international organizations' ongoing development of AI regulations and policies globally. Responsible AI can guide the localization, customization and optimization of AI for outcomes aligned with Arab region countries' priorities and the mitigation of any potential harm caused by AI, taking into account local culture-specific ethics and values while enshrining universal principles.

Individual countries in the Arab region have already taken some measures to adopt national responsible AI stipulations. For example, Egypt launched the Egyptian Charter for Responsible AI in 2023. Jordan created a National Charter on AI Ethics, published its National AI Code of Ethics, in 2022. The United Arab Emirates launched the "UAE Charter for the Development and Use of Artificial Intelligence" in 2024, which outlined ethical AI development and use principles. In 2024, the Global Index on Responsible AI included 16 countries in the Arab region out of a total of 138 countries; the index offers a practical tool for the responsible use of AI. To date, fewer than 10 per cent of 138 countries assessed score above 50 (out of 100) on the index.

Specific implementation steps for the development of an "Arab Region Charter for Responsible AI" could include: devising a dynamic assessment tool aligned with the Global Index on Responsible AI; working with regional and global think tanks to promote and assess responsible AI in the region; and promoting and incentivizing responsible AI solutions at different levels (government, business, research, education, civil society). Regional organizations (for example, the Arab League or the MENA Observatory on Responsible AI) and international organizations (for example, UNESCO or OECD) could also be valuable collaborators aiding in the development of the charter.

Devise and adopt a tool that countries in the Arab region can use to operationalize linkages between their AI strategies and their national visions/long-term development plans

Fourteen countries in the Arab region already have national AI strategies: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait,

Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates. Twelve countries have national visions.[53] Morocco has its Digital 2030 and Lebanon has its National Health Strategy, which are comparable strategies. The pathway outlined in this chapter looks to linking these national AI strategies with countries' respective visions. The prospects for maximizing the positive outcomes of this pathway would be increased if countries had a dashboard for aligning these linkages, mapping planning activities to priority aims, and monitoring and evaluating performance leveraging a key performance indicator and objectives and key results methodology.[54]

A number of countries around the world have adopted or are considering key performance indicators and objectives and key results frameworks for linking actions to important national priorities. For example, the National Agency on Corruption Prevention in Ukraine implemented objectives and key results to set and achieve anti-corruption goals in a more transparent, accountable and agile manner. This enabled the agency to adapt to changing conditions, streamline its operations, and allocate resources more efficiently. It also helped foster innovation and take stakeholder needs and experiences into account when setting objectives and measuring results. In the United States, the Nicholas Institute for Environmental Policy Solutions at Duke University recently developed methods using a key performance indicator development approach aimed at helping Governments support climate adaptation and resilience planning. The brief outlines general outcome key performance indicators for adaptation planning such as operational response and recovery effectiveness, stakeholder inclusion, measures of equity in resilience outcomes, and the state and function of relevant ecosystems and environmental conditions.

Countries in the Arab region could bring together representatives from their national policy and planning entities (ideally spanning multiple ministries), national research and planning institutes, academia, and other stakeholders to implement this recommendation. They could develop a practical dashboard tool that could capture and convey information about key performance indicators and objectives and key results related to desired linkages between AI strategies and specific goals and objectives in national visions. Ideally, the dashboard would be a common baseline tool that all countries in the region could then customize based on their distinctive needs. The specific key performance indicators and objectives and key results to be tracked in the dashboard would be decided by individual countries based on their distinctive visions and priorities.

Diversify partnerships for AI innovation to include a wide range of countries from the Global South, especially Africa, including triangular cooperation alliances that also involve international organizations, high-income countries and businesses

AI innovation is not limited to countries in the Global North or countries with advanced industrialized economies. A pathway of leveraging partnerships to adapt AI to local priorities in the Arab region will be most successful if it encompasses the collaborators that best contribute to those priorities, anywhere in the world. Countries in the Arab region will continue to build partnerships with AI leaders in the Global North. Cultural alignments will make partnerships between Arab region countries and countries throughout Africa and elsewhere in the Global South valuable in ways distinctive from Global North partnerships.[55]

Countries in the Arab region should look to establish modes of triangular cooperation, where two or more Global South countries collaborate with another partner to together devise innovative and adaptable solutions to challenges and opportunities in Arab region countries' unique contexts. Another dimension could be South-South and triangular cooperation where "traditional donor countries and multilateral organizations facilitate South-South initiatives through provision of funding, training, management, technological systems, and other forms of support".[56] Forms of triangular cooperation may be more sensitive than other types of partnerships in terms of local cultures and contexts, involving local communities, and respecting and benefiting from cultural diversity.

A number of models could be considered. One is the triangular cooperation project facilitated by the Islamic Development Bank with Mauritania and Tunisia, targeting financial inclusion in Mauritania by adapting mobile-based financial services. Others include the new G20 Co-Lab on Trilateral Cooperation, the Global Partnership Initiative on Effective Triangular Cooperation, the United Nations Office for South-South Cooperation South-South Galaxy, and the OECD Knowledge Hub on Triangular Cooperation. In September 2024, the Chinese Ministry of Foreign Affairs upheld the central and coordinating role of the United Nations in promoting international cooperation to bridge the AI and digital divides. United Nations efforts were described as ideally including North-South, South-South and triangular cooperation based on principles of sovereign equality, development orientation, people-centred shared benefits and inclusiveness, and multi-party coordination and cooperation.

Establish a regional AI researcher exchange programme

A regional exchange program for AI researchers should be established to strengthen collaboration between technical and social science researchers across countries.[57] This initiative could provide opportunities for mobility within the Arab region, ensuring that researchers from every country can work in advanced research or industrial ecosystems in specific AI applications. This approach would allow expertise to be shared more effectively and contribute to capacity-building across different institutions. International cooperation beyond the Arab region should be a core component as well as within the region, with structured exchanges involving AI researchers at institutions in the United States, China, India, other Asian countries, and countries throughout Europe, Latin America and Africa. The programme should include both universities and private sector actors. Companies developing AI technologies should host researchers. This structure would create stronger links between research and application, supporting innovation that responds to both economic and societal needs.

The valuable outcomes of international collaboration in research are well known, and several international models provide useful insights for leaders in the Arab region to consider. Programmes such as the Italy-United Kingdom Short-Stay initiative and the Sweden-Singapore AI Exchange demonstrate how short-term mobility can create lasting academic and professional connections. In these cases, researchers spend defined periods in partner institutions, building skills and working on joint projects. Other initiatives like the United States-Japan University-Corporate AI Partnerships have integrated industry actors into research collaborations, ensuring that academic insights contribute to technological development and inform developers' ethical considerations. Private sector-led exchanges show how workforce mobility can also strengthen the ecosystem.

Host institutions should be selected based on their expertise in specific AI applications, ensuring that participating researchers can work in environments that match their skills and research interests. The initiative would require coordination between Governments, universities and industry stakeholders to establish clear guidelines on participation, funding mechanisms and expected outcomes. Drawing from the experiences of existing exchange programmes, the focus should be on creating sustainable collaborations that continue beyond the initial exchange period, strengthening AI ecosystems across the region.

3

Lustre Art Group/via adobe stock

Pathway 2: AI and identity in the Arab region

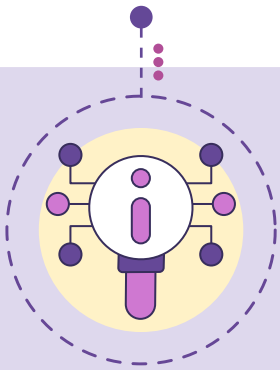
A. Linking who we are and what AI can be

It is increasingly critical to consider the questions AI raises about the future of human agency and human cultures. AI can be developed and used to create economic and other values in new ways that cement its usefulness within the cultures that underlie economies. It can be employed to preserve, promote and celebrate those cultures. Public, private and other-sector actors have the opportunity to explore to unlock the power of AI at the intersection of humanity and value.

The previous chapter considered a pathway for the future of AI in the Arab region in which countries invest in customized adaptations of AI to put this transformational technology at the forefront of their solutions for national priority goals. Another, possibly complementary pathway could see investment in developing and employing AI in service to objectives rooted less in individual nations' priorities, and more in the languages, cultures and identities of the Arab region more broadly.

One dimension of this pathway is to accelerate and scale the development and use of LLMs and other types of AI models built on Arabic-centric data (Arabic language text and images, video, audio, and code rooted in and reflective of Arabic cultures). Leveraging these models offers enormous potential for boosting the levels and forms of economic and other value creation in Arab region markets, industries and other types of enterprises.

Another dimension is the opportunity that countries in the Arab region have to safeguard and nurture their cultural heritages and identities in ways never before possible via AI applications that preserve, recover, and restore those cultures for future generations.



In a **2024** survey, "one-third of all respondents were regularly using **generative AI** in at least one function, meaning **60 per cent** of organizations with AI adoption were using generative AI".

Research showed that at "one company with **5,000 customer** service agents, the application of generative AI increase issue resolution by **14 per cent** an hour and reduce the time spent handling issues by **9 per cent**".

B. Across industries and sectors, language models and other generative AI tools are transforming how everything is done

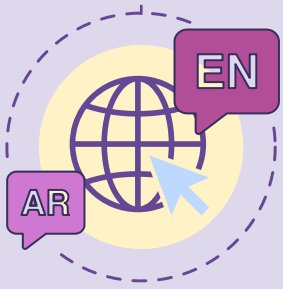
AI, especially generative AI, is fuelling far-reaching changes in the operations of businesses and other types of enterprises and in the ways they create value. Tools like ChatGPT and Google's Gemini, routinely called LLMs, are increasingly multimodal large language models (MLLMs). These models fuse in a single tool the ability to leverage and generate not only text, but also other types of data such as images and audio. These multimodal models are creating generative outputs that are transforming how functions are performed across industries and Governments.

The impacts are already being seen in a multitude of forms, from productivity improvement, to process reengineering and automation, new kinds of data analytics, cost and other efficiencies, development of new kinds of products and services, customer service experience enhancement, decision-making enhancement, and more. LLMs and MLLMs are enabling redesigns of business and industrial processes through their ability to analyse huge datasets to identify inefficiencies, suggest potential improvements, and even generate new versions of the process. In a 2024 survey, "one-third of all respondents were regularly using generative AI in at least one function, meaning 60 per cent of organizations with AI adoption were using generative AI".[58]

Generative AI is changing and expanding how value is created in organizations. Customer service functions are one area improvements are being seen, as self-service improves due to the high quality of chatbots' natural language processing abilities. Research showed that at "one company with 5,000 customer service agents, the application of generative AI increase issue resolution by 14 per cent an hour and reduce the time spent handling issues by 9 per cent".[59] Product companies can use generative AI to personalize an individual's online shopping experience, leveraging multimodal inputs to analyse a customer's preferences and purchase history "to help customers discover the most relevant products and generate personalized product descriptions".[60]

Process quality control functions are also being revolutionized, in industries including energy, chemicals, manufacturing and many others. Generative AI-enabled visual inspection offers unparalleled accuracy, speed and consistency in identifying defects in products and processes, surpassing traditional manual inspection methods. This can be particularly useful in, for example, the oil and gas industry, where some facilities are so large that it would take years to inspect everything manually. Healthcare is another area where generative AI is changing old ways of operating and creating improved, more efficient, and in some cases entirely new processes. It can read scans and point out problems as accurately or more than technicians can, it can suggest diagnoses and treatment protocols, summarize doctors' notes and prepare insurance claims, and more. The use of AI foundation models in research and development can even aid in the design of new drugs and materials.[61,62,63]

LLMs and other generative AI tools are transforming value creation across sectors around the world, including in the Arab region. Yet the models driving these transformations are mostly in the English language. Generative AI tools built and trained on Arabic language and other data rooted in values, culture and people pertaining to the Arab region will transform enterprises even more meaningfully.



Most LLMs are English language models, because they are primarily trained on content from the Internet. Estimates of the amount of Internet content in **English** vary between 50 per cent to nearly **70 per cent**. The number of **Arabic** websites is less than **1 per cent** of the global total, and it is not in the top fifteen by language.

C. Drawbacks and risks of generative AI tools built on non-native languages

There are disadvantages users contend with when using generative AI tools trained predominantly on data in non-native languages. These include biases, diminished accuracy of results (due to poor proficiency in the user's native language), misinterpretations of idiomatic and other linguistic differences and other cultural contexts, and inappropriate or offensive responses for a cultural setting.

Currently, most LLMs are English language models, because they are primarily trained on content from the Internet. Estimates of the amount of Internet content in English vary between 50 per cent to nearly 70 per cent. The number of Arabic websites is less than 1 per cent of the global total, and it is not in the top fifteen by language. English is the highest resourced language by multiple orders of magnitude, meaning it has the largest volume of digitized text, recorded speech, and other annotated resources, which are all being used to train LLMs. These tools' outputs therefore conform to the culture of the training data.[64]

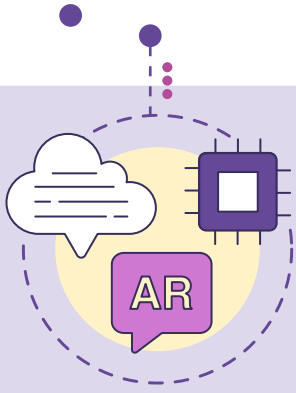
This is also true in multilingual AI models. Because they are disproportionately trained on English language text, they transfer values and assumptions encoded in English into other language contexts. These multilingual models "use English internally, even when they are prompted in another language ... and then translate to the target language at the very last moment". The resulting risk is "superimposing a limited world view onto other linguistically and culturally distinct regions".[65]

AI models' biases toward the cultures of their training data languages have material consequences for users with different native languages and cultural contexts. This can create discriminatory outcomes depending on users' race, gender or ethnicity, limiting their access to opportunities and perpetuating economic inequality. As AI is rapidly becoming more widely employed in schools, educational outcome inequalities may already be emerging. Such outcomes also pose legal, reputational and other risks to organizations employing biased models. There are more urgent, even life-threatening, impacts in the healthcare context, for example. In one study, unequal representation of members of different demographic groups in the datasets used to train AI algorithms caused "computer-aided diagnosis systems to return lower-accuracy results for African-American patients" in the United States.[66] Importantly, such biases in AI tools are not rooted in the language of the training data but rather in attributes of the culture of the model developers.

Consequences of non-native language AI model biases are visible in other ways. In 2024, Chinese researchers looked at the ability of AI models to generate results reflective of traditional Chinese medicine, which is rooted in millennia of Chinese wisdom and differs fundamentally from western medicine. Four LLMs developed by Chinese companies performed more than twice as well as four from western developers on sets of questions from the National Medical Licensing Examination for traditional Chinese medicine, and on the Japanese medical licensing exam. This is probably due to western LLMs being primarily trained on English datasets, lacking deep familiarity with Chinese culture, language nuances and traditional Chinese medicine concepts.[67]

For organizations in every sector in the Arab region, generative AI tools built on Arabic text and other data will be key to ensuring the value creatable with AI is not diminished by the negative impacts of biases inherent in models that have been trained in other languages and cultures.

In August **2024**, **G42** released twenty Jais follow-on models, the largest release of production-ready models in the Arab region. Further progress is being fuelled by a **$1.5 billion** investment in G42 by Microsoft.



Trained on a dataset of **400 billion words** of high-quality **Arabic** text, Fanar stands ahead of other Arabic models, with a range of different dialects.

D. Arabic language generative AI tools are emerging and already having an impact

The challenges of developing Arabic language AI models are considerable. All such efforts face challenges that are specific to the language, as well as the shortage of Arabic digital data. As described by Ashraf Elnager at the University of Sharjah, "the complexity of Arabic makes it extremely challenging compared to other languages, simply due to its many dialects, variants, and rich morphology".[68] Yet progress on Arabic LLMs and other generative AI tools is accelerating in the region and elsewhere. This is driven by recognition of the economic growth it can fuel; recognition of the prospects it offers for positioning in the global tech economy; and recognition of the inherent value of reflecting native language and culture in how AI is utilized in enterprises and people's everyday lives in the Arab region.

A family of models called Jais became available in August 2023 from collaborative development between Abu Dhabi AI company G42, Mohammed bin Zayed University of Artificial Intelligence, and United States-based Cerebras Systems. Jais has been recognized as more accurate than other Arabic LLMs with respect to reflecting linguistic nuances in the models' outputs. In August 2024, G42 released twenty Jais follow-on models, the largest release of production-ready models in the Arab region. Further progress is being fuelled by a $1.5 billion investment in G42 by Microsoft.[69]

The Qatar Computing Research Institute at Hamad Bin Khalifa University has developed a series of LLMs named Fanar. Trained on a dataset of 400 billion words of high-quality Arabic text, Fanar stands ahead of other Arabic models, with a range of different dialects. For example, it recognizes differences in pronunciation and morphology between Syrian, Algerian and Egyptian speakers. The training also included an extensive dataset focused on Qatari heritage, culture and traditions. This reflects the project's aim of empowering the people of Qatar with advanced tools that preserve Qatari cultural identity.[70]

In Saudi Arabia, the NEOM AI company Tonomus is working with Chinese tech giant Huawei on the AraMUS LLM, while the Saudi Data and Artificial Intelligence Authority is collaborating with IBM to develop ALLam. Other Arabic language generative AI tools include Rayan, developed by the Saudi Ministry of Human Resources and Social Development; Mulhem, the first LLM trained exclusively on Saudi datasets; Noon; and SauTech, a speech-to-text-conversion software model able to recognize and process a range of dialects.[71]

While LLMs get much of the attention, small language models (SLMs) may hold even greater promise for developing generative AI applications capable in diverse Arabic dialects. SLMs process and generate human language with fewer parameters than LLMs. Their smaller size makes them customizable to perform well on niche applications. This makes them usable by developers with modest tech-stack resources, creating the prospect of accelerating growth of native language generative AI models and applications in middle income and less-developed countries. SLMs can also accelerate development of niche AI tools trained on different dialects, opening up the benefits of generative AI to the millions of speakers of those dialects.

United Arab Emirates tech company Tarjama& recently released a family of SLMs called Pronoia for translating Arabic business, legal and medical content.

In September 2024, researchers at MBZUAI released the Atlas-Chat-2B and Atlas-Chat-9B SLMs, trained on Moroccan Arabic Darija dialect and other Arabic dialects. The Atlas-Chat project has three objectives: "to make AI more accessible for Darija speakers by providing models with a higher level of understanding for the dialect; making [these models] freely accessible via open-source licenses; and releasing small-size models that can be used in resource-constrained environments".[72] This kind of strategy can empower small- and medium-sized enterprise businesses and freelance developers to work with and build on AI tools, along with stimulating other Governments and research institutions to increase their development of SLMs and LLMs for all Arabic dialects.

E. The differences that Arabic language generative AI tools will make are substantial

AI models generally perform better when trained and used in a user's native language, with superior understanding of nuances and cultural context generating more accurate and relevant responses, though their performance is dependent on the quality and quantity of training data and other factors. Countries in the Arab region will see multidimensional societal benefits if they concentrate generative AI efforts on models and applications built on Arabic language text data and reflective of Arab region culture and values.[73]

1. Arab region consumers will see significant improvements in their experiences as customers in a range of ways, and businesses will gain access to new local and global customers

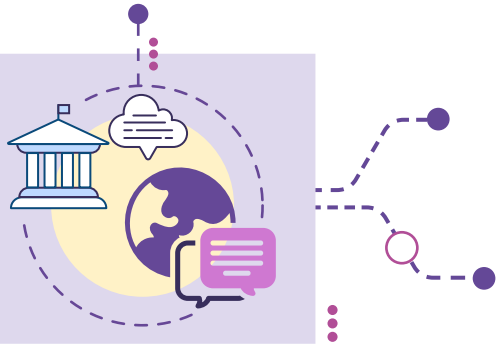
The accuracy of the linguistic understanding of Arabic generative AI tools, the naturalness of the content and responses they will generate, and their sensitivity to cultural nuances will produce deeper connection between businesses in the Arab region and their customers and other stakeholders.

Tools with high capabilities in Arabic language understanding, reading comprehension and common-sense reasoning will generate marketing content more easily understandable to Arabic-speaking customers of all dialects, and with a higher (and ever-increasing) degree of resonance with and respect for cultural norms and values. They will also offer improved understanding of customers' needs and views gathered from sentiment analysis on data they generate in reviews they post online, and their social media posts and videos. Companies like Amazon, Bank of America, Ford Motors, T-Mobile, and others use generative AI in these ways. The same ability to do so with Arabic dialect-trained models will transform businesses and consumers in the Arab region.[74]

Development of sophisticated Arabic-speaking chatbots will enable businesses to handle customers' inquiries with highly accurate natural language understanding in Arabic dialects. This will enable high-satisfaction customer service automations and create access to previously unreachable customer pools where these dialects are spoken. These phenomena are already being seen in India, a country with considerably more languages and dialects than the Arab region. Indian tech company Sarvam AI recently introduced tools that Indian businesses can use for voice rather than text interactions with customers in ten different local native languages and mixed-language conversations voice bots with the potential to reach a billion people.[75] Similar tools to engage speakers of Arabic dialects will expand businesses' markets and customers' options, in the region and for Arabic speakers anywhere in the world.

The future impact of native language generative AI tools on customer experience has importance well beyond the retail and consumer domains. Essential government services are

The future impact of **native language** generative AI tools on customer experience has importance well beyond the retail and consumer domains. Essential **government** services are increasingly being provided to citizens around the world through **digital** means. AI innovations will dramatically enhance these transactions by enabling people to engage in their native language and make services available to individuals previously without access.



increasingly being provided to citizens around the world through digital means. AI innovations will dramatically enhance these transactions by enabling people to engage in their native language and make services available to individuals previously without access. The United Nations offers an example of how native language trained models for social listening can have great effect on enhancing government services. Since 2019, generative AI tools have been used to analyse radio broadcasts to gain insight into how to better serve citizens in remote areas where local dialects are spoken, using tools designed to do automated speech recognition in the Ugandan, Acholi and Luganda languages. In the United Arab Emirates, a ChatGPT-powered bot called U-Ask enables citizens to engage in both Arabic and English for government services. Sehha is one of several AI-assisted apps developed by the Government of Saudi Arabia for providing and coordinating healthcare services to citizens. Schools, hospitals and philanthropic institutions will also be able to engage with the communities they serve in new ways.[76]

2. Development of Arabic language generative AI models and tools will help fuel job creation and business creation throughout the region

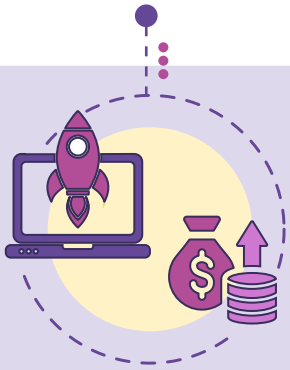
AI in the Arab region is already creating new jobs and stimulating the proliferation of startups and other new businesses. A specific focus on developing Arabic language models and tools will further fuel this in unique ways.

Some future AI jobs will be technical ones where the language the models are trained on may make little difference. Other technical jobs will be specific to developing Arabic language models or will call for individuals who are fluent in the language and culture. An example of the latter type of role is computational linguists, specializing in analysing linguistic data to identify patterns and trends, to develop the algorithms that power Arabic language customer service chatbots and speech recognition software. Another is human-centred machine learning designers and engineers, for whom understanding of the distinct needs of Arabic-speaking users will be essential.[77]

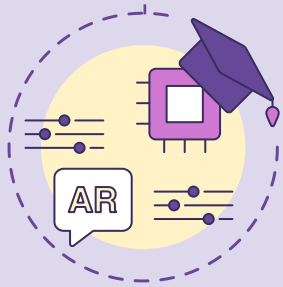
Beyond the technical job roles, there are many other types of roles important to both the development and the practical use of Arabic language generative AI models and tools. Many of these will require native speakers of the language the models are built in. This will create job opportunities as the development and use of Arabic language generative AI scales.

One additional new type of job is in the creation of Arabic language-centric datasets to train and power these AI models and tools. There are jobs related to increasing currently limited Arabic digital data resources and uploading them to online repositories or making them available in other ways for model training. This will entail digitizing printed Arabic text, creating culturally significant digital images, making audio recordings of people speaking in Arabic dialects or uploading audio from Arabic films and television and storytellers. Such jobs could be filled by people in rural areas and other regions where annual incomes are low and economic opportunities are few. Karya, a nonprofit launched in 2021, is doing this and improving the lives of men and women in poor remote villages in India.[78]

There will also be a further boom in job creation and other forms of economic growth in the region's tech sector startups from the development of Arabic language generative AI tools. There were more than 1,800 AI startups in the region as of April



There were more than **1,800 AI startups** in the region as of April **2024**, enabled by funding rounds generating a cumulative total of nearly **$13 billion**.



Arabic language generative **AI models** and tools will provide a number of substantial enhancements in the **education** systems of countries in the Arab region.

2024, enabled by funding rounds generating a cumulative total of nearly $13 billion. The Saudi Arabia National Strategy for Data and AI is providing public investment and stimulating private investment to fuel AI startups and other AI-related company and infrastructure growth. In December 2024, Abu Dhabi-based companies, investors, government entities and technologists together launched Hub71+AI, a specialist platform designed to accelerate AI startups, with access to locally developed bilingual LLMs and global partners including Amazon, Google and Nvidia. Many of the AI startups that will proliferate in the Arab region will focus on developing Arabic language models and apps that can only be built on native language models.[79]

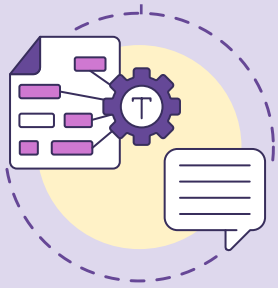
3. Education for students and learners at every level will be improved and enriched by employing Arabic language generative AI tools

Arabic language generative AI models and tools will provide a number of substantial enhancements in the education systems of countries in the Arab region. They will enable high-quality educational content to become more accessible to and engaging for students from different linguistic dialect backgrounds. They will also enable more personalized learning for student speakers of these dialects in core subjects like maths, science and history.

All of the GCC countries have initiatives in place for integrating AI into their educational systems. Algeria, Egypt, Jordan, Kuwait, Mauritania and Tunisia all include education as a priority sector in their national AI strategies and digital economy plans. AI is a key element of the ICT in Education Policy and Masterplan under development in Somalia with support from UNESCO. Iraq announced in May 2024 its decision to begin using AI in the school curricula. In Morocco, officials are "actively incorporating generative AI into our educational framework … while ensuring [its] use aligns with our values".[80]

India offers an example of the benefits of employing of models trained on Hindi, Tamil, and other native languages and dialects on the education system. Chief among them is personalized and adaptive learning experiences for student speakers of these dialects, as content and feedback is tailored to their individual needs, preferences and progress. There are also learning efficiency benefits – having content in their native dialect and the ability of the multilingual models to translate quickly and easily from one dialect to another will "help students learn better and faster and avoid the cognitive load of learning in a foreign language".[81]

Multilingual generative AI can also enhance students' multicultural awareness, familiarizing them with the languages and traditions of their fellow students of different backgrounds. For example, "a multilingual LLM can generate stories, poems, songs, or jokes in different languages, and explain the meaning, context, and nuances of the words and expressions used … along with insights on the history, geography, literature, and art of different regions and communities".[82]



With **English** as the dominant language on the Internet, more than **1.5 billion** of the world's **eight billion** people cannot use their language to navigate the digital world. Arabic language LLMs and other generative AI tools are essential for enabling millions of people to navigate it who cannot today.

4. Generative AI tools capable in Arabic dialects will play an important role in advancing digital equity and open the AI-enabled future to millions in the region

In May 2024, United Nations Deputy Secretary General Amina Mohammed outlined several imperatives for the global community with respect to AI. Among them was to "not simply take AI models and data sets [as they are currently being developed] – we need inclusivity in the data that underpins these models, and diversity among the people building them".[83] With English as the dominant language on the Internet, more than 1.5 billion of the world's eight billion people cannot use their language to navigate the digital world. Arabic language LLMs and other generative AI tools are essential for enabling millions of people to navigate it who cannot today. In addition to equity, these tools are an important element of AI capacity-building in the Arab region.

The equity impacts of AI models and tools accessible to speakers of native language dialects will span from education to healthcare, financial inclusion, and other areas. In Rwanda, text- and voice-based AI translation models with capacity in multiple languages and dialects enable thousands of community health workers to diagnose conditions in individuals with whom they do not share a common language. They can also refer those in need of urgent care. A similar impact is being seen in Senegal through the locally developed Kera Health app which provides people in rural areas important health information and engagement with doctors through an AI assistant that can converse in five different languages.[84]

The financial inclusion impacts of Arabic language models in the region's fintech sector will be significant as well. Between 50–70 per cent of the population in the Arab region is unbanked or financially underserved, making it the region with "the lowest proportion of adults with a financial account in the world".[85] Integration of AI into local mobile digital banking apps could change this meaningfully in the future, making access to financial services equitable. Linguistically diverse Arab region citizens will have easy to use AI-driven tools to assess their creditworthiness using alternative data sources. This will open up microloans to people without formal credit histories to start small businesses or make other investments in their future.

F. An important and rapidly emerging role for AI in the preservation of Arab region cultural heritage

Countries in the Arab region can use AI to safeguard and nurture their individual and shared cultural heritages and identities in ways never before possible. The possibilities of what AI can do in this context can help ensure that centuries of tradition endure for future generations.

These possibilities range from reconstructing damaged works of art and historically significant cultural sites, to translating ancient texts for analysis, to powering immersive virtual environments that recreate long-lost historical sites and figures. AI can deepen understanding of connections between artists, artifacts and the socioeconomic and other historical contexts in which they worked and were created. It can help validate the integrity of collections of cultural artifacts against forgeries or illegal trade. AI can even help preserve intangible cultural heritage: "the traditions and living expressions that are transmitted from one generation to the next – community

gatherings, oral traditions, songs, knowledge of natural spaces, healing traditions, foods, holidays, beliefs, cultural practices, skills of making handicrafts, methods of agriculture and cattle breeding, traditional navigation skills, cooking skills, etc".[86] The Arab region is immensely rich in expressions of culture and identity. AI offers unprecedented new means of securing them for the enrichment of millions of people.[87]

AI for cultural heritage preservation could become a focus for leaders in every sector. There is a natural interest in every culture to invest in heritage preservation, and models are emerging around the world for mechanisms to leverage the potential of AI for these objectives. The European Commission in February 2022 pointed out how AI can serve the "Treaty obligation of the [European Union] to preserve and promote its cultural diversity and history". They have since embarked on creating Europeana, a "common European data space for cultural heritage" with the aim of building "collaborations and partnerships [between] museums, galleries, libraries, and archives [and a] network of data partners, aggregators, and experts in digital cultural heritage".[88] Officials in Malaysia are working at the intersection of the country's National Culture Policy, National Digital Infrastructure Plan and Ministry of Education to integrate AI into efforts to protect and preserve traditional practices and other aspects of Malaysian culture.

G. AI use in cultural preservation around the world could inspire initiatives in the Arab region

AI is already supporting cultural heritage preservation globally. One example is the work of researchers at University of Rome La Sapienza to analyse the exterior of the Colosseum. They are using AI algorithms to "identify erosion patterns and subtle structural shifts, enabling restoration experts to implement targeted interventions that are effective and respectful of the Colosseum's historical integrity".[89] Another example is the restoration of the Notre Dame Cathedral, where AI enabled architects, engineers and restoration experts to analyse multiple digital databases and archives containing images of the cathedral and other information. This allowed for recreating the physical structure and interior artworks to match the original colours, textures and other details used 850 years ago.

1. AI in the preservation and restoration of historic sites, artifacts and artworks

Countries in the Arab region can look to numerous examples of AI research and development for site and artifact preservation. An international consortium of partner institutions has been working since 2021 on a project named RePAIR. The aim is to "virtually eliminate one of the most laborious and frustrating steps in archaeological research, namely the physical reconstruction of shattered works of art". The integration of robotics with computer vision and other elements of AI "envisages a future where archaeology can deal effectively with reconstruction problems at an unprecedented scale".[90]

Another example is Arch-I-Scan, in development at the University of Leicester, identifying and archiving artifact fragments by using custom designed algorithms similar to those of facial recognition software. The tool is compiling a dataset projected to grow to hundreds of thousands of digital images of Roman tableware and other ceramic fragments. The results are being made available open source to researchers around the world to inform "archaeology in response to socially oriented questions" about the people who used the vessels and their culture.[91]

The are approximately **400 million** Arabic language speakers around the world. The growth of generative AI language models could endanger non-English languages, even major ones not currently considered endangered. Between **50–90 per cent** of the **7,000 languages** in the world will be extinct by the end of the century, in part due to the Internet and digitalization focusing attention on the usage of a few major languages.

2. AI in the preservation and restoration of important historical texts

AI can also reconstruct missing or damaged sections of texts. LIms trained on the language of a book or text can analyse datasets of similar texts in order to learn the linguistic patterns and style of the original document. Using the resultant knowledge, it can then predict what words or phrases would most likely fill the gaps in the damaged text. Text reconstruction with AI need not be limited to printed material. Researchers at Oxford University and Google DeepMind have been working since 2018 to restore inscriptions made by the ancient Greeks in stone, pottery, metal and other surfaces damaged over centuries. Handwritten texts are also becoming easier to analyse and reconstruct with AI.[92,93]

Given the complexities and nuances of the Arabic language, reflective of the numerous place-specific, ethnic and other subcultures within the Arab region, the capabilities AI offers for enhancing understanding and preservation of heritage in the form of text are especially significant. There is pioneering work already being done in this area by Arab region researchers and the prospects for results from such innovations are promising. One example the work of Tunisian librarian Said al-Barouni to preserve a cache of ancient texts of the Ibadi branch of Islam "because old Arabic cursive is challenging to modern readers".[94] Others include Ashaar, a project for analysis and generation of Arabic poetry employing AI deep learning, and AraPoemBERT, an AI model custom designed at Taibah University in Saudi Arabia for analysis and understanding of Arabic poetry texts.[95]

3. AI in the preservation of the Arabic language itself

The are approximately 400 million Arabic language speakers around the world. The growth of generative AI language models could endanger non-English languages, even major ones not currently considered endangered. Between 50–90 per cent of the 7,000 languages in the world will be extinct by the end of the century, in part due

to the Internet and digitalization focusing attention on the usage of a few major languages. At the same time, the value of AI for preservation of all languages, including Arabic, is high and will grow in the future.[96]

In late 2022, Google launched the 1,000 Languages Initiative, aiming to build a single AI model capable of performing a breadth of tasks including language generation, translation and others in 1,000 languages. It is "combining technical innovation with community engagement, with Google researchers collaborating with speaker communities to collect language data, then developing new methods for training AI systems on the datasets including audio recordings, text, and others".[97] The Stanford University Initiative on Language Inclusion and Conservation in Old and New Media was initiated in 2024 with the aim of encoding "endangered languages into standard formats, facilitating their preservation and integration into AI applications".[98]

Efforts to develop Arabic language LLMs like ALLaM, Jais and Fanar will help preserve the Arabic language for future generations. Efforts to factor Arabic dialect diversity into such LLMs and other AI tools will have a range of cultural heritage preservation impacts. For example, as voice-activated chatbots become one of the dominant forms of generative AI, it will help safeguard against so-called accent neutralization. Speakers of every Arabic dialect will be understood in their natural speaking patterns when engaging with voice-activated AI tools, in a way that today's English-dominated models do not allow. This is important because "accents are a part of cultural identities that need to be nurtured and cherished – an honest signal of native-group membership".[99]

4. AI in the preservation of other aspects of culture in the Arab region

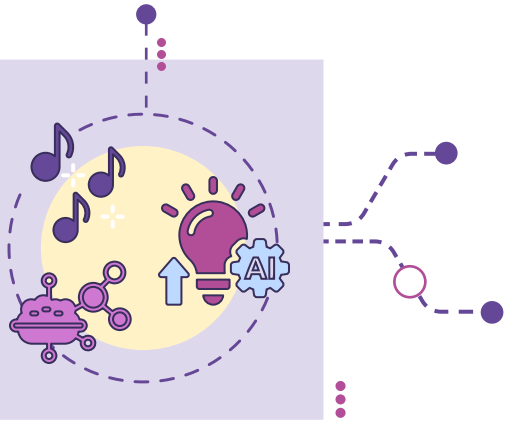
AI is also helping to archive music, rituals, traditions related to food, skills and traditions related to making handicrafts, and other aspects of culture in societies around the world. The Arab region can look to them as models and inspiration for how to use AI to safeguard their own traditions.

For example, researchers in China are collaborating on an effort to develop an AI-based framework for preserving Manchu music. The AI models being used are even generating new Manchu music segments that accurately adhere to the traditional styles. In another initiative in Vietnam, researchers are using AI to preserve traditional musical instruments.[100]

AI can play a role in the preservation of cuisines as well, for example "analyzing culinary data to unearth unique flavour pairings and suggest ingredient substitutions that respect the roots of traditional dishes while accommodating contemporary dietary preferences".[101] Here, AI might suggest ingredients with a reduced environmental footprint, such as plant-based substitutes for animal products.

Oral traditions and craftmaking traditions are other important forms of cultural heritage. In early 2024, researchers at the University of Munich developed "a novel virtual space that combines first-person virtual reality with generative AI-driven narrative personalization" to bring a centuries-old storytelling ritual from Afro-Caribbean culture into the modern age. In Hong Kong, researchers are using generative AI to preserve

AI is also helping to **archive music**, **rituals**, **traditions** related to **food**, **skills** and traditions related to making handicrafts, and other aspects of culture in societies around the world. The Arab region can look to them as models and inspiration for how to use AI to safeguard their own traditions.



a method of painting a distinctive type of porcelain vessel that is a distinct folk art of the Lingnan region of China. The project includes "a novel user-friendly interface [through which] today's young generations and future generations can create new vessels that "closely adhere to the traditional style, [extending] the history and culture".[102,103]

5. AI makes previously unrealizable cultural heritage preservation efforts possible

Throughout the world, countless culturally significant artifacts and sites remain inaccessible, and others lie undiscovered, due to topographic and other challenges. Efforts to excavate known ones and search for unknown ones are costly and difficult, but AI if offering new possibilities.

For example, tech company WSense is leveraging acoustic modems and sensors powered by AI to enable advances in underwater archaeology in Baiae, an ancient Roman city submerged off the northwest shore of the Gulf of Naples. With AI, the system can adapt to changing sea conditions in real time without interruption of data transmission, making it possible for researchers to remotely explore the site in new ways. It is anticipated that access to the site could become a tourism opportunity through interactive smart tablets. In the Netherlands, dense forests in the Utrechtse Heuvelrug and the Veluwe have historically made it difficult to find culturally significant ruins, including burial mounds that researchers knew were present. Since 2019, researchers have been employing AI in concert with light detection and ranging technology and making breakthroughs that "will inform about [local] past societies and be added to the national database of known archaeological features and protected for posterity".[104]

In 2025, the culture sector comprises **6 per cent** of the global **economy**, with estimated annual revenues of more than **$4 trillion** annually. The **tourism** industry is an important source and driver of wealth creation in the Arab region, estimated at **$275 billion in 2024** with projected growth to more than **$450 billion by 2034**.

H. The benefits of investing in AI for cultural heritage preservation are significant

From the standpoint of economic growth, a rise in the number of significant artworks, sites and other aspects of Arab region cultures made accessible through AI will positively impact tourism, job creation in the restoration and preservation, and more. The consequent growth and spread of awareness of Arab region cultures will have its own intangible benefits. It could contribute to second-order economic benefits such as increased trade, as this cultural understanding strengthens relationships of trust, or as countries in the Arab region becomes more attractive to emigres as places to live and start businesses.

1. Prospects for economic growth benefits from AI-enabled cultural preservation

In 2025, the culture sector comprises 6 per cent of the global economy, with estimated annual revenues of more than $4 trillion annually. The tourism industry is an important source and driver of wealth creation in the Arab region, estimated at $275 billion in 2024 with projected growth to more than $450 billion by 2034. Even without AI, evidence of economic growth from heritage preservation initiatives is strong. The cultural sector revenue in Saudi Arabia is projected at nearly $48 billion

per year by 2030, reflecting major government and private sector investments in the revitalization of landmarks such as Diriyah. Egypt has boosted archaeological site restoration and expansion investment to stimulate cultural tourism, with tourism industry growth projections at more than 7 per cent annually over the next 5 years. As AI enables further cultural preservation efforts, the figures for 2025 and beyond could grow to even greater levels. Increased cultural tourism is one of the greatest prospects for economic growth in the Arab region due to the ability of AI to accelerate and scale cultural heritage restoration and preservation efforts.[105]

A prominent AI-enabled cultural initiative already well under development in the region is the Journey Through Time master plan, a $15 billion ongoing investment of the Saudi Arabian Government for preservation and related tourism and sustainable development in the Alula Valley. AI is being used to power immersive augmented reality (AR) tours, allowing visitors to virtually reconstruct historical sites, access real-time information about locations, and engage with the ancient past through interactive elements. With AR, visitors can walk through sites that are partially ruined or no longer exist.[106] Universities and other academic institutions are also becoming engaged. One example is the Digital Sirah Project, underway since 2018, which aims to create "the world's most comprehensive digital portal on the life of the Prophet Muhammad, making it accessible and engaging to the public, particularly youth, through AI elements".[107]

AI also offers the prospect of greater engagement with Arab region cultures by people and institutions around the world as it is further integrated with VR and AR technologies to create immersive Metaverse tourism. This will have direct economic benefits for countries in the Arab region as companies and Governments develop and market these virtual cultural experiences. The integration of AI with VR creates the possibility of giving people anywhere in the world the ability to see landmarks in the Arab region and also "experience cultural practices and traditions, and even engage with digital twins of ancient people who may have established those traditions generations ago".[108] Examples include a VR environment for the celebration of Saudi National Day in 2022, created to make the history and culture of Saudi Arabia accessible to the rest of the world, and an AI-powered Metaverse experience of the Temple of Eshmun in Lebanon.

To illustrate, the large-scale effort to restore buildings, streets and other elements of the ancient Walled City of Lahore in Pakistan created jobs for **1,500 skilled craftspeople** and manual labourers, and "demand for **conservation skills** has increased in the region ever since".

Preservation and restoration work is labour intensive and requires people to fill a wide range of roles. Every new project will increase jobs. To illustrate, the large-scale effort to restore buildings, streets and other elements of the ancient Walled City of Lahore in Pakistan created jobs for 1,500 skilled craftspeople and manual labourers, and "demand for conservation skills has increased in the region ever since".[109] As AI enables new cultural restoration and related projects, more jobs will be created for preservation professionals, architects, engineers and others. Jobs for AI technicians will also be created to complement and enable physical site preservation efforts.

2. The role of AI in fostering cross-cultural mutual understanding

Cultural heritage preservation is promotes awareness, understanding and appreciation of ideas and traditions. AI offers powerful new capabilities to archive cultural heritage and make accessible, with considerable benefits to society. Innovations in AI foster inclusiveness and empathy within and between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communities, and in some cases promote conflict resolution across a diversity of different sects, ethnicities, religions or local identities.

The United Nations Department of Political and Peacebuilding Affairs, partnering with United States-based AI company Remesh, is using machine learning and other AI tools to facilitate and process information from large-scale social listening dialogues among citizens in conflict situations. "By identifying and combining actors' identities and their respective voices, the AI offers a fine-grained picture regarding topics, themes, and narratives important to different identity groups. By applying filters to the responses, the moderator sees in real time, for instance, how many women, or members of an ethnic minority group, express a certain view."[110] The tool is able to process audio data collected in the local dialects of people engaged in the dialogue. The United Nations Department of Political and Peacebuilding Affairs has already employed it in dialogues in Haiti and Bolivia, and in Arab region countries including Libya, Iraq, Yemen and Lebanon. Other United Nations-led or supported initiatives are employing AI in other ways to engage with groups involved in conflict to foster mutual understanding within and between these groups. One example is in the peace process in Columbia, and another is in Uganda.[111]

Mutual understanding through familiarity with cultural heritage strengthens relationships between countries.

Growing global awareness and appreciation of Arab region cultures through AI-enabled cultural exchange will foster empathy, helping position peoples and countries on the global stage in contexts ranging from popular media and entertainment to international finance institutions and standard-setting bodies. It will also help safeguard against a drawback of globalization – cultural homogenization potentially eroding the vibrance of other cultures. In light of that risk, efforts to preserve and promote Arab region cultures take on a greater importance and AI offers powerful means of doing so. Investment in AI applications will contribute to accelerating and scaling global partners' understanding of the region and its people, with diplomatic, economic and other benefits. It can also stimulate new business partnerships, interest from entrepreneurs and others in starting businesses in the Arab region, and other kinds of international engagement opportunities.[112]

AI can also contribute in unique new ways to building positive shared multicultural identities within and between countries in the Arab region. In many of these countries, people of different sects, ethnicities, religions or local identities are living together. Individuals who have immigrated from one country to another strive to feel connected to both their culture of origin and culture of residence. Novel applications of AI offer can build bridges between individuals and communities that share cultural elements while also celebrating unique elements of their identities.

I. Recommendations aligned with this pathway

Four recommendations align with this pathway. They are not exclusive in their relevance to this pathway, as they could also be supportive of other pathways outlined in this report or with other pathways that policymakers and other leaders might pursue.

Establish a regional fund and leverage it to design and implement a region-wide collaborative project and platform Arab Region Cultural Heritage: Past, Present, and Future – Enabled with AI

The Arab region is diverse and possesses a wealth of cultural heritage ranging over thousands of years. There are numerous initiatives in individual countries for preserving, restoring and disseminating this heritage, including a number leveraging AI. A collaborative and mutually supporting project spanning countries across the region would enable aspects of culture shared across countries to be recognized, celebrated and preserved in ways beyond what is achievable in individual projects. AI offers tools to achieve using a unified methodology in one smart, dynamic, interactive digital platform or an integrated set of platforms.

The project should incorporate a well-planned and structured collection of content spanning the different components of Arab region cultural heritage including historical artifacts, art, architectural sites, texts, poetry, literature, science, music, cinema, food, textiles and languages. The project could be conducted in phases and would be contingent on collaboration between the different countries in the Arab region. It could be led by a steering committee with representatives from high-income, middle-income, less developed and conflict-affected countries. Collaborators and supporters could include multilateral partners and museums, libraries and universities throughout the region. A joint fund could be established to design and implement the project with contributions commensurate with available resources from different countries and partners.

The project will unveil the wealth, depth and complexity of Arab region cultural heritage and civilizations of the region. It will promote peace and communication with other cultures and communities of the world and also highlight links to other civilizations. It will celebrate the nuances and the complexities of the region's languages, histories and peoples. It can serve as the go-to online platform for Arab region cultural heritage. It would also provide new work opportunities, on site and remotely, for every participating country.

Scale the Arabic language digital content for AI models and applications by promoting production and curation of multimedia outputs, connecting and opening digital knowledge platforms and archives, and supporting production of localized datasets

Data and texts in the Arabic language publicly available online are very limited compared to their English counterparts. The result is "insufficient training data to develop accurate and reliable AI systems – fewer annotated datasets available for Arabic natural language processing hinders the development of advanced models and AI".[113] The limited Arabic content does not only hamper the development of indigenous AI models, it also reduces the adaptability of AI models to local solutions. Countries in the Arab region, individually and in a variety of collaborative efforts, should launch a series of coordinated initiatives to expand the reservoirs of local datasets to support the development of localized AI models. Two lines of effort could be pursued in parallel.

One is the curation and digitization of exiting content, making it available for AI model training and other uses in Arab region digital economies. A number of specific projects could comprise this content curation effort. Countries could work together to establish an Arab region open knowledge platform with links to various existing online sources of Arabic language digital content and archives (e.g., Arabic Collections Online, the Digital Library of the Middle East, the Arabic Union Catalog and the Digital Archive for the Study of Pre-Islamic Arabian Inscriptions). Platform designers could collaborate with global entities and initiatives on open data and also liaise with regional knowledge hubs. Feeding this platform could be a multi-country project to digitize public domain Arabic language content archives, as well as sources like Arabic movies, television shows, radio broadcasts etc., capturing distinct dialects, morphologies and accents with generative AI tools that compute videos and images as well as text.

A second line of effort should focus on the production and collection of new Arabic language data. This effort could be fuelled with seed funding from countries' ministries of communication or other sources for the collection of disaggregated data at the grassroots level using tools such as sensors, crowdsourced data, and audio recordings of storytellers in cities and villages. Other projects could include fellowships and competitions for Arabic language content creators (bloggers, musicians, videographers); partnering with schools on joint programmes in Arabic language digital

content creation by primary and high school students; and working with civil society to raise awareness and enhance digital literacy and expression, especially for women and marginalized communities.

Coordinate public and private sector efforts to develop generative AI tools built on Arabic language-centric content within an ecosystem of small and large language models and action models reflective of diverse dialects and other contexts

The pathway outlined in this chapter provides evidence of the benefits of integrating Arab region cultures into AI models. These models must account for the diversity of dialects and other manifestations of culture in the Arab region. Given that the region's computing capacity and other relevant infrastructure is also diverse, a particular focus should be on small language models and small action models (SAMs), which combine language computing with logic and reasoning to execute specific tasks. This would benefit not only middle-income and less developed countries, but also those with greater resources given how smaller models are easy to deploy locally and are tailorable to leverage local datasets and local cultural and linguistic contexts. Smaller models offer effective AI solutions to communities, furthering inclusion and fostering preservation of unique cultures and languages.[114]

Key stakeholders in the Arab region should undertake a coordinated set of actions to promote the development of a thriving ecosystem of such models. This can be done through a series of practical steps. One would be to build and support innovation hubs, bringing together academia and startups to promote a thriving ecosystem and emphasize scaling SLMs/SAMs. Others could be to provide targeted support to academia through research grants and research competitions; incentives for startups to build SLMs/SAMs, such as subsidies, tax exemptions or financing technical support; linking model development efforts to Arabic language data curation and collection initiatives; collaborating with Arab region technologists and entrepreneurs in diaspora; and funding from multilateral or development organizations to Arabic language AI model ecosystem development.

Establish a rigorous testing and evaluation programme to validate Arabic language LLMs for preferred use in the provision of government services in the Arab region

Governments in the Arab region should prioritize the adoption of LLMs specifically designed for local languages in the provision of their services to citizens, other residents and visitors to their countries, ensuring they meet high-performance standards before deployment. Only models that demonstrate improved representation of diverse demographic groups and that align with sustainability goals should be

integrated into public services. Developing Arabic language LLMs is already a growing priority in the region. Such models, with improved Arabic language capabilities in AI applications, should be recognized and embraced by Governments for their potential to provide more accurate, context-aware and culturally relevant interactions for users engaging with government services. Governments must carefully assess their feasibility, sustainability and performance before large-scale adoption in the services related to healthcare, education, public safety and other essential needs.[115]

To ensure these models are suitable for government services, rigorous evaluations should be conducted, comparing them with general-purpose LLMs. This assessment should focus on accuracy, cost-effectiveness and the ability to reduce biases, particularly in underrepresented dialects and demographic groups. Research has shown that LLMs trained on specific linguistic and cultural datasets can outperform general models in local language comprehension and contextual adaptation, but Governments must have evidence of such results.

One of the main challenges for locally trained LLMs is the vast amount of data and computational resources required, which often centralizes AI development in a few well-funded institutions. A promising way forward is federated learning, which enables multiple entities – universities, government agencies, private sector actors – to collaboratively train and fine-tune LLMs. Methods like FedBiOT, which optimize computational efficiency in federated learning settings, can help Governments develop high-performing native language LLMs. Evaluation and confirmation of superior or comparable performance relative to general purpose models could be built into these federated development efforts. The same performance evaluations for accuracy, cost-effectiveness and ability to reduce biases prior to use in providing government services should be applied to native language models that Governments from external developers as would be applied to government-developed models.

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Pathway 3: AI and the SDGs in the Arab region

With only 5 years until 2030, evidence shows countries around the world are behind, and in some cases are even losing ground, on **80 per cent of the 169 targets** that comprise the SDGs.

A. Juxtaposing trends of great importance

Considerable work is being done globally on applying AI to the SDGs and substantial progress is being seen. With only 5 years until 2030, evidence shows countries around the world are behind, and in some cases are even losing ground, on 80 per cent of the 169 targets that comprise the SDGs. At the same time, AI today is accelerating and scaling at an astonishing rate. What the technology is capable of, the number of contexts in which it is being applied, the number of entities engaged in advancing its development and the level of investment going into it all are advancing at incredible speed.

Countries around the world should recognize the juxtaposition between the slow pace of SDG progress and the accelerated pace of AI advancement as a call to action. A third pathway for the advancement of AI in the Arab region is to accelerate and scale the application of AI against specific SDG targets strategically, with the aim of closing the gap on the 80 per cent of targets that are at risk of not being met.

There are hundreds of initiatives underway to design AI applications to meet SDG targets around the world, and a number of them are being pursued by and in countries in the Arab region. Continuing to generate and experiment with new ideas is necessary. At the same time, this moment in time may also call for identifying subsets of SDG targets that may be of particular importance to individual countries or to the Arab region as a whole, and subsets of proven or in-process AI developments. Countries could then marshal resources to move these innovations from pilots to scale to meet these priority challenges. This pathway explores what this could look like, in individual countries or in multi-country or even broader regional collaborative initiatives.

Nearly 50 agencies within the United Nations system contributed, reporting on more than **400 projects** – nearly **20 per cent** more participating entities and nearly **50 per cent** more projects than the previous year. These efforts reflect a strong and growing commitment to cross-sector collaboration in bringing AI into global efforts to achieve the SDGs.

1. Initiatives to bring AI and SDGs together for impact

In 2024, the United Nations published its annual compilation of projects underway or planned that aim to develop and deploy AI-enabled systems and tools in support of the SDGs. Nearly 50 agencies within the United Nations system contributed, reporting on more than 400 projects – nearly 20 per cent more participating entities and nearly 50 per cent more projects than the previous year. These efforts reflect a strong and growing commitment to cross-sector collaboration in bringing AI into global efforts to achieve the SDGs. Of the projects, 24 per cent are in collaboration with one or more Government, 20 per cent are joint efforts with academic institutions, and 17 per cent involve private sector entities working with United Nations agencies. They span all 17 SDGs, with some Goals seeing particular attention including SDG 3 (Good Health and Wellbeing), SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), SDG 13 (Climate Action), SDG 16 (Peace, Justice and Strong Institutions) and SDG 17 (Partnership for the Goals). The majority of the projects address more than one SDG, signalling holistic multidimensional efforts reflective of the intentional integrated nature of the framework of the Goals as defined in 2015. In 2023, one of the signature efforts within the United Nations system to harness the power in support of the SDGs, the AI for Good platform, coordinated by the International Telecommunication Union (ITU), saw over 1 million online views and its online community grew to over 100,000 individuals, institutions, networks and groups, with representatives from more than 180 countries.[116]

The work on AI to support and accelerate progress on the SDGs extends beyond the efforts of United Nations agencies and their multi-sector partners that the ITU is documenting. In May 2024, scholars at Google identified more than 600 AI use cases that have been developed specifically to support SDG targets by organizations in the social impact sector, such as non-profits, companies with dedicated social impact initiatives, social entrepreneurial enterprises and philanthropic foundations. This represents a 300 per cent increase in the application of AI to address the SDGs since a 2018 survey of such work conducted by McKinsey. These efforts are advancing progress on all 17 of the SDGs and include "scaled use cases, where AI applications have demonstrated impact and opportunities for full scale potential could still be realized".[117]

In 2020, research drawing on hundreds of experts from around the world arrived at a consensus conclusion that AI is already helping or is capable of helping in the achievement of 79 per cent of SDG targets (134 targets), while noting that 35 per cent (59 targets) could be negatively impacted by AI. Negative impacts are primarily rooted in two factors. One is that the massive (and growing) amount of energy required for computing power to develop and deploy AI poses risks to achieving SDGs related to climate and clean energy. The second has to do with the fact that "AI-based developments are traditionally based on the needs and values of nations in which AI is being developed, [which] might enable nationalism, hate towards minorities, and bias election outcomes" in other geographies.[118] This poses risks to SDGs related to gender equality, reduced inequalities, justice and strong institutions, and others.

2. Progress on the SDGs is concerning …

Data are abundant and clear on the overall state of SDGs achievement worldwide. Data indicate an urgent need for policy, technology and other interventions, including

As of June **2024**, none of the 17 SDGs are on track to be achieved by 2030, and only an estimated **16 per cent** of the SDG targets are progressing measurably.

AI interventions, to dramatically accelerate progress. As of June 2024, none of the 17 SDGs are on track to be achieved by 2030, and only an estimated 16 per cent of the SDG targets are progressing measurably. Approximately one-third of the 169 SDG targets are stalled or regressing, with regression demonstrated in 11 of the 17 Goals ranging, from 10 per cent of a Goal's total targets (SDG 17) to 50 per cent of targets (SDG 2), and more than 30 per cent of the targets in three other Goals. In three of the SDGs (1, 6 and 13), no targets are currently on track.[119]

Reports from the United Nations and other sources on SDG progress paint a widely varying picture based on geography, which is partly reflective of the level of economic development or resources of the countries in question. Sustainable Development Report rankings (calculated as percentage of SDG achievement, with a score of 100 indicating that all SDGs have been achieved) show 19 of the 20 top-ranked countries are in Europe, although these countries also face significant challenges in achieving several SDGs. The coalition of BRICS countries have made faster progress than the world average over the past decade, and countries in East and South Asia have made the greatest overall progress.[120]

In the Arab region, 14 ESCWA member States rank in the middle third among the 193 members of the United Nations committed to the SDGs, with seven others in the bottom third. Progress is clearly visible despite a variety of recognized barriers including conflict and instability in some countries, climate change impacts, the COVID-19 pandemic and institutional issues. A number of important steps forward over recent years were recognized by the United Nations Deputy Secretary General in March 2024, including rising sustainable energy development; improvements in food security and sustainable food systems in many countries, notably Jordan and the United Arab Emirates; initiatives in Bahrain and Oman to boost social protection benefits; and reduced gender gaps in schooling. Achievement levels in the Arab region are significant, with a score of 61 averaged across the region, and several countries above 70, compared to the average of the top ten ranked countries at 83. However, the remaining required progress constitutes considerable challenges and hardships in every country in the Arab region – a reality equally true for the top ranked countries throughout the world.[121]

3. … but AI can offer an inflection point

The number and diversity of AI initiatives already in use or being developed for supporting and advancing the SDGs is considerable. Most are in relatively early stages of deployment, with relatively limited scope and scale. These pilot-scale implementations offer promising indicators of positive impacts, but data on demonstrated impact are modest and have not yet been analysed systematically. Measurement of the impacts on SDGs is being explored by AI for Good and its partners. Consolidation of the results of such evaluations would offer important insights to guide future efforts.

The pace of advancement in technology could significantly affect the currently modest scope, scale and impact of these AI applications. The number of patents issued globally for AI innovations in 2022 was over 62,000, 30 per cent more than in 2021 and more than twice the number in 2020. In 2023, private sector industry developers released 51 notable machine learning models, while just four were released a decade earlier. The number of foundation models released in 2023 was

The number of **patents** issued globally for AI innovations **in 2022** was over **62,000, 30 per cent** more than **in 2021** and more than twice the number **in 2020**. **In 2023**, private sector industry developers released **51 notable machine** learning models, while just four were released a decade earlier.

twice that released in 2022 (149 compared to 72), with the 2022 figure representing nearly three times the 2021 number. Global investment in generative AI in 2023 stood at $25 billion, 9 times the level the year prior and 30 times the 2019 level. Across sectors, 55 per cent of organizations reported having adopted AI and integrated it into their operations, compared to 20 per cent in 2017. In 2023, there were 75 countries with national AI strategies, only 6 years after Canada published the first such strategy in 2017.

Putting the full potential of this technology to work to advance the SDGs, through near-term policy, investment, partnerships and other actions, offers a pathway for AI development that has the potential to create futures of unprecedented promise.

B. Seizing on the inflection point as a pathway for AI in the Arab region

The key to AI development in the Arab region is prioritization. While the number of AI applications being pursued for supporting the SDGs is important and necessary, a spread of resources across so many initiatives inevitably keeps the scale and of impact of each effort modest. A survey conducted in 2024 with more than 60 experts from the social sector in 17 countries revealed that "most efforts to deploy AI for social good to date have focused on research and innovation rather than adoption and scaling". Moreover, "55 per cent of grants for AI research and deployment across the SDGs are $250,000 or smaller, consistent with a focus on targeted research or smaller-scale deployment rather than large-scale expansion".[122] Specific AI innovations being developed or already employed to advance SDG achievement could be selected and prioritized by leaders in Arab region countries to be scaled for far greater impact.

Prioritization may also need to consider which SDGs, or targets with individual Goals, to focus on in prospective future efforts to scale AI initiatives. As the United Nations Development Programme (UNDP) and others have made clear since 2015, the 17 SDGs are integrated, action in one area affect outcomes in others. It is crucial that development balances social, economic and environmental sustainability.[123] Leaders should make careful choices to prioritize certain targets of Goals that can create results that also promote positive outcomes in other areas.

Prioritization should shift the focus of global funding of SDG-supportive AI efforts to deployments in the region. Research shows that "only 10 per cent of grants allocated toward AI initiatives that address one or more of the SDGs went to organizations based in low- or middle-income countries".[124] Investment by Governments and private sector entities in AI is growing rapidly in many countries in the Arab region. One element of a strategy for countries pursuing this pathway could be to prioritize growing portions of that investment to scaling AI developments for selected SDGs. Partnerships with investors and AI developers to focus more of their efforts on SDG-supporting initiatives and advocacy in multilateral forums could be other elements.

1. Seeing the impacts of AI on SDGs can inform leaders' prioritization

To visualize this pathway for the future of AI, policymakers and other leaders in the Arab region should consider the possible outcomes of today's efforts to apply AI to the

SDGs. The examples selected and described below are not a prescription for which SDG targets to focus on, or for specific types of AI applications to choose to scale. They are intended to inspire thinking about which efforts to scale initiatives will create the most meaningful outcomes on particular SDG targets.

No Poverty

Enhancing access to financial services for under-served populations

AI can enhance access to financial services for underserved populations in a range of ways. One is use of AI applications in microfinancing for entrepreneurs. By utilizing non-traditional data sources, such as mobile phone usage and social media activity, AI-powered tools are transforming credit scoring, powering alternative data models that enable financial institutions to assess creditworthiness for individuals without access to traditional banking and without formal banking histories. In the digital banking context, AI is enhancing mobile applications, making banking accessible and user-friendly for underserved communities. AI is also being used to design personalized financial products and services like microloans and insurance plans that meet specific needs of low-income populations. By empowering people to manage financial risks and build stability, AI promotes pathways out of poverty. The integration of AI into financial services contributes to economic empowerment and poverty alleviation in several important ways. One is economic resilience – access to loans and microinsurance reduces vulnerability to financial shocks, enabling people to make investments in income-generating activities. A second is savings growth – AI powered mobile banking platforms encourage financial discipline and futureproofing through structured saving options. AI-driven solutions also reduce dependency on costly in-person financial services, making banking more accessible and affordable.[125]

Zero Hunger

Optimizing farming practices and enhancing crop yields

Agriculture- and food-related use cases are the second highest growth area of AI development after healthcare. More than 50 AI use cases described are impacting the SDGs most related to agriculture and food security. One that is projected to be of high impact is for crop monitoring, using satellite imagery and machine learning algorithms to identify issues such as nutrient deficiencies, pest infestations or water stress. Another is AI-driven predictive analytics models to forecast pest outbreaks or crop diseases, allowing farmers to take timely preventive measures. Others include AI-driven tools to recommend optimal planting times and crop varieties based on local soil and weather conditions, and AI-powered logistics systems to predict food demand and improve supply chain efficiency to minimize waste. Researchers in India are developing an AI framework model for self-sustained farming in which these and other AI technologies are all integrated and working in concert to enable important precision farming breakthroughs. The United Nations Food and Agriculture Organization is developing and deploying AI tools that perform crop monitoring and other critical functions. One is the Hand-In-Hand Geospatial Platform, which is performing "cutting edge quantitative remote sensing in agriculture and enabling unprecedented cross-sectoral knowledge discovery by integrating data on soil, land, water, climate, fisheries, livestock, crops".[126] Another combines time-series satellite remote sensing data, machine learning, and AI-powered geospatial data analytics tools to manage the growth and yield of crops from planting to harvest with improved understanding of how environmental and management factors affect them. The benefits of AI technology to the aims of SDG 2 are numerous. One is increased productivity – enhanced crop yields contribute to improved food availability, reducing food shortages and supporting market supply. A second is food security – AI enables better resource management, for example by enabling sustainable farming practices that adapt to climate change. A third is labour efficiency – automated systems reduce the burden of manual labour while improving decision-making for farmers.

Good Health and Wellbeing

AI-enabled predictive analytics and wearable health devices

AI is at the forefront of health monitoring and forward-looking care through predictive analytics and wearable health devices powered. Wearable devices provide AI-powered real-time monitoring of metrics like heart rate, activity levels and sleep patterns. An individual's historical and live health data can be analysed to predict risks and enable early preventive care, and even to trigger alerts for emergency responses. AI platforms are able to collect data from sensors to remotely monitor and track the health of patients with chronic conditions. Such applications

democratize healthcare access, enhance patient outcomes, and support global health priorities under SDG 3. Deployment of AI-powered health technology wearable devices and other AI-enabled predictive health analytics offers numerous beneficial outcomes. One is early detection and prevention, as real-time insights and predictive tools reduce the risk of serious health conditions, lowering overall healthcare costs. A second is improved chronic disease management – remote monitoring allows for continuous care and support for patients with long-term conditions. AI tools also make healthcare more accessible, particularly for people in remote or underserved areas. There is a cost reduction benefit as well – by preventing severe health crises, AI helps minimize expensive medical interventions and hospitalizations.[127]

Inclusive and Quality Education

Enhancing educational outcomes through personalized learning experiences

AI technologies can create personalized learning experiences by analysing student performance data and tailoring educational content to match individual learning styles and needs. This enables all students, regardless of their background or challenges, to receive a tailored education. Personalization of the classroom or other learning experiences through AI-powered analysis helps teachers identify each student's specific strengths and areas for improvement and adjust their learning paths accordingly. AI tools also can customize learning materials based on the data analysis to suit each student's learning pace and style, whether they require more time on certain topics or prefer a more accelerated path. In Rwanda, a pilot project used AI to help high school students enhance their skills in maths through personalized learning and exercises.[128] AI can provide students immediate feedback on their work, helping them stay on track and highlighting areas they need to focus on. Work on developing and deploying AI tools for personalizing learning has been underway for some time, for example in a $240 million investment by the Bill and Melinda Gates Foundation in 2016. The impacts are already being seen and will accelerate as AI advances. One impact is improved learning outcomes, with AI-driven personalized learning leading to better retention and comprehension. Another is more efficient learning – students learn at their own pace, allowing for more efficient use of study time and resources. AI also contributes to equalizing access to education, helping students anywhere can have high-quality, customized learning experiences. It can also improve learning confidence, as personalized AI-assisted learning helps students grasp challenging concepts and provides quick feedback.

Gender Equality and Women Empowerment

AI for improving maternal health

AI technologies are contributing to SDG 5 by improving maternal health outcomes, for example providing personalized healthcare recommendations and support to prevent complications during pregnancy. Algorithms can analyse data from expectant mothers and provide tailored advice on nutrition, exercise and prenatal care. AI systems also can serve as early warning systems, monitoring vital signs and health indicators to detect signs of potential complications such as preterm labour, high blood pressure or gestational diabetes. When a risk is identified, the AI system can send alerts to healthcare providers and patients, enabling early intervention and reducing the likelihood of severe complications. Impacts already being seen, such as reduced maternal mortality. AI-driven early warnings and personalized care identify complications before they become life-threatening, enabling care providers to intervene in a timely way.[129]

Sustainable Water Management and Sanitation

AI-enabled smart water management systems

AI is transforming water management by optimizing the distribution, quality and usage of water in a variety of important ways. For example, AI tools are able to continuously monitor water quality in real time, detecting fluctuations or contaminants in the water supply at a municipal or enterprise level. They are also increasingly deployed for predictive maintenance, able to detect when pipes, pumps or treatment plants need attention based on data analytics. This helps reduce the risk of breakdowns and improves the reliability of the systems in which they are used. Another application of AI is to analyse data on usage and demand to help ensure water is used efficiently, an application particularly valuable in the Arab region and other areas with worsening water scarcity. There are a number of benefits of AI in support of SDG 6. One is greater assurance through real-time monitoring that water quality standards are maintained, helping prevent spread of waterborne diseases in drinking supplies. AI-driven resource usage optimization also helps ensure equity and efficiency in water allocation, increases water quantities available for use, and helps to reduce energy and chemical usage in water management.

Predictive maintenance and optimized water distribution with AI tools also can reduce operational costs, making water utilities more affordable and efficient for public use.[130]

Affordable and Clean Energy

AI innovations and clean energy

AI is being leveraged to enhance the efficiency and sustainability of energy systems, including in some countries in the Arab region, particularly in the areas of energy generation, distribution and consumption optimization. These applications are tackling the challenges of improving energy system performance while at the same time minimizing environmental impact. On the supply side, AI technologies help optimize how energy is generated. For example, AI tools can analyse meteorological and other data to forecast solar generation capacity and help solar operators plan for balancing out the intermittent nature of supply. On the demand side, AI systems are demonstrating their unique utility in monitoring and analysing energy usage to provide consumers with recommendations and adjustments to optimize their consumption patterns. With this, they can take actions such as storing solar-generated power in batteries for use at peak need times. These and other applications of AI are helping ensure that clean sources such as wind and solar are used effectively to meet the growing demand for electricity globally, with the Arab region projected to be one of the greatest demand-growth regions. The impacts will be considerable. For example, there will be efficiency gains, as AI-driven solutions help optimize energy generation, distribution and consumption, thereby reducing waste and lowering carbon emissions. AI will also enable potentially significant energy cost savings – by enhancing system efficiency, it can help reduce operational costs and improve affordability for consumers.[131]

Decent Work and Economic Growth

AI in workforce development

AI is creating a need for workers to adapt to a rapidly changing job market. At the same time, AI tools will help workers get the reskilling and other forms of professional development they need for the future job market, including training and development for job roles that will not be affected by AI. A projected six in ten current workers will require additional training within the next 4 years. Estimates vary that between 40 to 60 per cent of jobs worldwide will be exposed to AI, necessitating reskilling and other support. A growing percentage of this support will be able to be provided by AI tools. AI-driven educational platforms offer tailored learning experiences based on individuals' learning styles, career goals and areas of interest, helping ensure they are equipped with the most relevant skills. AI tools can also continuously reassess workers' skills and recommend customized training programmes to enhance employability. Tools are also emerging that leverage AI to provide career counselling for workers shifting roles, identifying new opportunities and pathways based on personal data and market trends. An important result will be increased economic resilience. By helping workers acquire new skills, AI prepares the workforce for changes. AI will also make skill development and career progression more accessible to a wider range of individuals, especially in underserved regions or communities.[132]

Industry, Innovation and Infrastructure

AI for predictive infrastructure maintenance

AI is being used to enhance the reliability and efficiency of infrastructure maintenance. In a growing number of cities around the world, AI-driven systems collect data on temperature, vibrations, structural integrity, environmental conditions and other factors from sensors and Internet of Things devices installed on infrastructure such as bridges, roads and buildings. AI algorithms can analyse this data in real-time to detect patterns and predict when maintenance will be needed. These predictive insights help schedule repairs before major issues occur, reducing the risk of infrastructure failure. Other AI systems can generate proactive maintenance schedules based on such predictions, helping ensure timely intervention and reducing unexpected disruptions. There are a number of already observed and projected beneficial impacts from the use of predictive infrastructure maintenance in support of SDG 9. One is the extended lifespan of assets and prevention of costly emergency repairs. A second is improved public safety as AI-generated predictions and accompanying preventive maintenance actions reduce or avoid life-threatening failures. A third is greater infrastructure resilience as AI systems' real-time adaptability enables them to continuously learn from new data to improve predictions and adapt to emerging issues.[133]

Reduced Inequalities

AI for accessible education

AI tools are increasingly capable of making education more accessible to a broader range of people of every age. This includes students with disabilities, students who have not traditionally had textbooks or other educational content available in their native dialects, and students that face other forms of marginalization in their opportunities to learn. AI tools include assistive technologies and personalized learning platforms that cater to individual needs. AI-enabled assistive technologies include speech-to-text and text-to-speech tools that can convert spoken language into text and vice versa, helping students with hearing or visual impairments engage with educational materials. Other tools use generative AI to create adaptive learning materials, tailoring educational content to match each student's learning style and needs. Such tools make it easier for them to access the material regardless of any disabilities they may live with, or any language barriers they may face in a multilingual classroom. They also enable teachers to offer ongoing support more easily to each student in a tailored way. The outcomes in support of SDG 10 are projected to be considerable. One impact is in helping equalize opportunities – AI can help ensure that students with disabilities or other types of barrier have equal access to education, promoting inclusivity and greater equity. Another is improved learning outcomes – by providing personalized learning experiences and continuous support, AI helps students achieve better academic outcomes.[134]

Sustainable Cities and Communities

AI for smart urban planning

AI-driven solutions can enhance urban planning and management in a variety of ways to create more sustainable and liveable cities. By allowing planners to integrate data from a plethora of sources and enabling them to conduct predictive modelling, AI helps optimize resources and manage urban growth effectively. Multisource data integration at scale is a powerful new capability for urban designers and redevelopers. AI integrates data from sources such as traffic patterns, environmental sensors, population demographics and citizens' social media activity to offer comprehensive insight into urban dynamics. Continuous real-time monitoring and analysis of this data helps predict urban trends and identify challenges. These predictions can feed AI models that can offer guidance on urban growth patterns, enabling cities to respond proactively and make informed decisions about infrastructure development and resource allocation. In these ways, AI helps build more sustainable, resilient cities that are better equipped to handle growth and environmental challenges and offer citizens enhanced quality of life. A range of specific impacts relevant to SDG 11 have already been observed and are projected to increase. One is optimized traffic management – by predicting congestion and suggesting alternative routes, AI reduces travel times and emissions for cleaner, greener cities. A second is improved energy management – AI systems monitor and optimize energy consumption in public buildings and infrastructure, promoting energy efficiency.[135]

Responsible Consumption and Production

AI for waste management

AI-driven solutions are optimizing waste management through the use of smart bins and optimized collection routes, contributing to more efficient and sustainable waste disposal. AI-powered smart bins are Internet of Things devices equipped with sensors that monitor the fill levels and types of waste placed into them. These sensors send real-time data to computer systems that are themselves leveraging AI algorithms for analysis of the collected data, enabling targeted smart waste management actions such as automated sorting for recycling and disposal. Other AI algorithms optimize waste collection routes based on real-time data, ensuring the most fuel-efficient and time-effective paths are chosen, which reduces operational costs. Collection schedules can be adjusted dynamically to meet demand, ensuring timely and efficient waste collection, especially in high-demand areas. One impact of the use of AI in this context is reduced waste and enhanced recycling rates. A second is financial savings – optimized routes and better scheduling lead to lower operational costs. There will also be reductions in carbon emissions from more efficient use of vehicles and optimized collection processes.[136]

SDG 13: Climate Action

AI for Climate Prediction

AI is enabling advances in climate prediction through advanced data analysis and early warning to help mitigate the impact

of extreme weather events. Machine learning algorithms are capable of integrating and analysing massive datasets from various sources such as satellite imagery, weather stations and historical climate data. This information, analysed as single-source datasets or integrated into multi-source datasets, provides new insight into climate patterns. Leveraging the results of these big data analytics operations, AI models are used to predict future climate patterns and potential extreme weather events (storms, droughts and floods), allowing for better preparation and response strategies. They monitor emergent patterns and produce results in real-time as well as making future projections, detecting changes and issuing early warnings. Based on predictions and on real-time observations, AI systems can recommend specific preparedness measures, guiding authorities and communities on how to respond effectively to mitigate damage. Through AI, authorities will have enhanced ability to prepare for and respond to climate-related disasters, reducing the economic and human cost of extreme weather events. Lives will be saved and injuries from disasters reduced as early warning systems allow communities to take proactive measures.[137]

Life Below Water

AI for marine conservation

New applications of AI have been developed to enhance conservation efforts by detecting threats to marine biodiversity. One is the use of AI-powered underwater drones to monitor marine life and ecosystems, capturing real-time data on species' presence and activities, water quality and environmental conditions. The data can then be analysed using AI algorithms to identify trends and detect potential problems. Fujitsu has developed a system combining light detection and ranging and AI to capture high-resolution 3D data from organisms and other undersea features. This comes under research and development efforts "to create ocean digital twins … to predict changes in the environment [and] simulate the possible effects of conservation measures".[138] AquaNurch is an AI-powered engine that gathers and processes millions of data points on ecological stressors on bodies of water. Other AI systems go even further, beyond just analysing collected data to flagging changes in marine ecosystems that indicate environmental stress. These tools inform conservation strategies, providing recommendations for authorities and environmental organizations that will help them design effective conservation strategies to protect vulnerable underwater species and habitats. Already observed impacts are expected to increase. One is proactive biodiversity protection – AI helps get in front of potential threats to marine ecosystems before they can cause irreversible damage. A second is in sustainable fisheries – AI promotes the development and enforcement of sustainable fishing practices, promoting the long-term health of fish populations and marine ecosystems.

Life on Land

AI for Wildlife Conservation

Researchers are pioneering and employing new applications of AI to monitor wildlife populations, track their movements, and predict poaching. For example, Conservation AI, a United Kingdom-based non-profit, has developed a solution


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involving AI-powered camera traps and drones to monitor wildlife populations in their natural habitats. Machine learning algorithms analyse the video data collected, identifying individual animals, monitoring migration patterns, and detecting any unusual behaviour or signs of danger. Researchers at the University of Würzburg in Germany have developed AI to do similar work for monitoring and protecting bird populations in Ecuador, using AI to analyse audio recordings to understand the birds' soundscapes. A professor at the University of Southern California developed an AI model that analyses historical data and patterns related to poaching and makes forecasts by identifying risky areas or behaviours, allowing rangers to prepare and intervene before illegal hunting can occur. Other AI systems generate real-time alerts based on monitoring data, notifying rangers of immediate threats. This enables swift intervention to prevent poaching or human-wildlife conflicts. The impacts of AI tools on SDG 15 objectives include increased biodiversity protection – AI helps protect endangered species by providing continuous monitoring and identifying threats before they can harm wildlife populations. Reduced poaching is another beneficial outcome – predictive analytics and real-time alerts allow authorities to take proactive measures, reducing illegal hunting activities. AI will also enable more effective data-driven conservation efforts, making it easier for conservationists to manage protected areas and wildlife reserves.[139]

Peace, Justice and Strong Institutions

AI for judicial efficiency

AI can play a role in improving judicial efficiency, transparency and fairness by automating case management processes, enhancing accessibility, and detecting biases in judicial decisions. AI systems can automate routine tasks in case management such as reviewing legal documents, organizing case files, and scheduling hearings. This allows courts to process cases more quickly and frees up time for judges and clerks to focus on complex matters. AI is highly effective in analysing case data to identify patterns, predict case outcomes, and suggest courses of action. It can also help prioritize cases based on urgency and complexity, ensuring that critical matters are addressed promptly. AI-powered platforms can also make court information accessible to the public, like case progress and decisions, and help detect and mitigate bias in judicial decision-making. Authorities need to be mindful of the risk of bias in AI training data leading to unjust case outcomes. By analysing past judgments and identifying trends of bias in them, AI can recommend adjustments to correct these, and over time to prevent them. There is already evidence of the beneficial impacts of AI systems in the judicial context. One is how AI reduces delays, speeding up case resolution and improving overall efficiency in courts. A second is that the increased transparency of case data and judicial decisions fosters trust in the legal system, making it more accountable to the public. A third is that by identifying and mitigating biases, AI contributes to more equitable outcomes, helping ensure that all individuals are treated fairly under the law.[140]

Partnerships for the Goals

AI for global health collaboration

AI can enhance global health outcomes not only by scaling its use in individual health systems around the world. It can also help improve health outcomes by enabling collaboration in different forms across country and sector borders. Increasingly over time, world health institutions will create AI systems that integrate health data from various countries, health organizations and institutions to create comprehensive global health databases. These databases can facilitate breakthroughs in identifying emerging health trends, predict disease outbreaks, and more. This can enable faster, coordinated responses to global health challenges such as pandemics. AI-driven platforms will also facilitate sharing of health data, research findings and best practices among global health organizations. These platforms help connect experts, policymakers and practitioners from different countries and sectors. Cross-border and cross-sector collaboration platforms are already emerging, such as the Global Initiative on AI for Health. One of its mission pillars is "to create a global community of experts and resources that foster knowledge sharing and collective action".[141] Another is the European Health Data Space, an ecosystem of rules, standards and practices, infrastructure and a governance framework to support the free movement of health data. AI will serve the objectives of SDG 17 in a variety of ways. One will be improved health outcomes through data-driven insights that support timely interventions and coordinated responses to health crises. A second is more efficient resource use – AI will help ensure that resources are used efficiently in global health initiatives, improving health interventions. A third benefit will be from how AI can optimize the allocation of resources for global health initiatives, helping ensure vaccines, medical supplies, healthcare personnel and other vital elements of public health are deployed where they are most needed.

C. Recommendations aligned with this pathway

Four recommendations align with the pathway outlined in this chapter. They are not exclusive in their relevance to this pathway, as they could also be supportive of other pathways outlined in this report or with other pathways that leaders in the Arab region might pursue.

Establish a region-wide job skill programme leveraging AI tools to empower and enable the demographic wealth of the region for future work and entrepreneurship

The Arab region has the highest rates of unemployment of young people, women and educated persons in the world, and the lowest rate of women's labour force participation. It also has the highest global rates of overall unemployment, and large percentages of the populations in many countries in the region work in the informal labour sector. These challenging conditions are partly due to the huge mismatch between the supply and demand for skills, stemming from the inability of education and training systems to fulfil current and future skill needs.[142]

A coordinated multi-country campaign to cultivate job-readiness skills in key demographics by leveraging AI tools could reduce the levels of unemployment and underemployment that characterize the Arab region. Designing and implementing a campaign to scale AI applications being developed for the education sector for the subset of SDGs that relate to work and economic opportunity would address a region-wide priority. AI-driven educational platforms would put training for job skills within reach of millions of people previously without access. A training campaign using AI could prepare young people, women, educated unemployed persons and informal sector workers for jobs in the formal economies of their countries. Programmes for skill development in AI would be a related but separate initiative.

Actions to move forward with an AI-enabled job skill development campaign could include creating an Arab region fund for human capital building with AI and establishing a regional hub to host skill development activities. Ideally, the hub should ensure equity by allocating country quotas for trainees and country representation on a steering committee. Programmes could focus on using AI-based training/education tools to develop skills for the future of work and entrepreneurship, such as basic job readiness skills (communication, teamwork, critical thinking, problem solving, professionalism, soft skills); financial skills; basic technical skills (project management, computer literacy), language skills for targeted business needs, and other skill areas critical to job readiness.

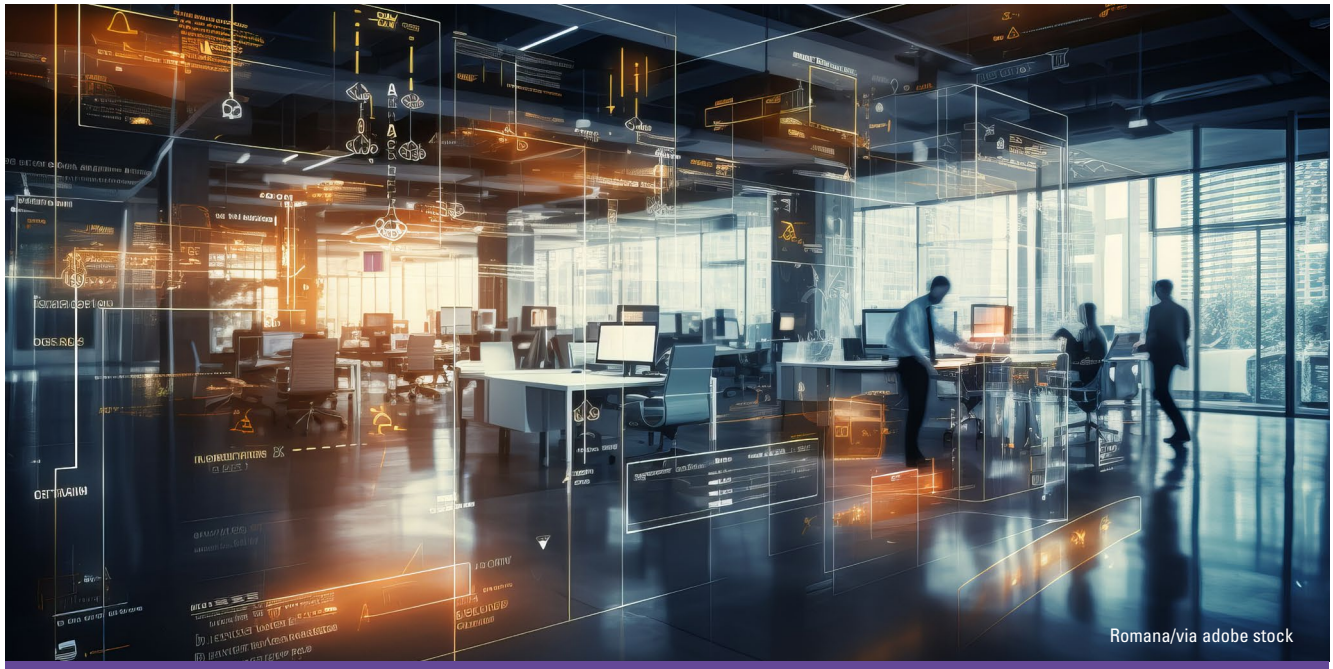
Implementation of this region-wide job skill development programme could leverage partnerships with multinational tech companies; education companies; universities in the region and outside the region; and others. Other partnerships could be with regional entities like ESCWA, the Arab League Educational, Cultural and Scientific Organization and the Arab Labor Institute. Governments in the region could engage and incentivize local entrepreneurs (with tax breaks or subsidies) to build tailored AI tools that would provide the necessary skill development for young people, women, unemployed educated people and informal workers.

Establish a network for regional research on AI for sustainable agriculture – linking and scaling promising initiatives and AI innovations that address food security

Food security in the Arab region has long been severely jeopardized, a problem exacerbated by the COVID-19 pandemic and by conflicts. Given the expected population growth and rising temperatures and other effects of climate change, there is a need to address these challenges by capitalizing on AI, the existing innovations in the region and the link to national AI policy prioritizations.[143]

Creating a network for regional research on AI for sustainable agriculture would help connect agriculture and food-focused AI startups with one another and with key stakeholders to scale climate-friendly practices and policies for food production and security, sustainable food supply chains and waste reduction in the Arab region. AI innovations fostered by the network that address food security would also help reduce poverty, reduce emissions, and improve health and wellbeing. The network could be led by a coalition of countries, potentially on a rotating basis.

The network could map the current landscape of sustainable agriculture AI innovations and startups in the area and link them. Locally developed agriculture and food-related AI applications and tools are already emerging in a number of countries in the region. The network could connect such innovators to relevant stakeholders (policymaking bodies, academia, civil society, farmers, manufacturers); other regional research initiatives and networks like AI for Development Africa; and international organizations like the International Food Policy Research Institute. In addition to



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detailed real-time research on the promise and perils of AI for agriculture and food security, the network could also establish a scorecard for responsible AI for sustainable agriculture to incentivize businesses and national policies; liaise with existing methodologies for tracking food and hunger-related SDGs; and engage with funding sources in the region and globally for assistance in scaling the most promising relevant AI applications.

Harmonize data legislation across the region to promote sharing of data on open-source platforms data and AI innovation for advancing the SDGs

AI applications and tools in support of the SDGs are booming, and the ones that scale will generate considerable amounts of data. A number of countries in the Arab region already have data legislation in place, including Bahrain, Egypt, Qatar and Saudi Arabia. These laws "differ in scope, enforcement, and requirements, making compliance a complex and resource-intensive task".[144] An effort to converge legislation related to data would help facilitate AI entrepreneurship and innovation, benefit consumers, and help regional collaboration in meeting the SDGs. All SDGs would be promoted and advanced with attention to data governance.

The foundation of such an effort could be to establish a regional working group on data legislation harmonization. The group could proceed in phases. In the first phase, participating entities could outline the benefits, challenges and costs of harmonization; review data protection and related legislation and regulations (those addressing privacy, freedom of information and other related issues); identify gaps and means to bridge them; liaise with representatives from the European Union and other international organizations for lessons learned from global efforts to codify data governance rules (including how data privacy rules can also support innovation objectives); and set a clear plan of action with feasible short-, medium- and long-term targets.

The second phase could focus specifically on how harmonized and clarified data governance rules across the region could facilitate innovation in AI in support of the SDGs. Activities of the working group could include assessing how harmonization could reduce barriers to innovation investment caused by restrictive data flow rules; foster greater regional economic integration and cooperation in support of scaling AI applications that impact the achievement of specific SDG targets; create a clearer compliance environment for AI startups and other businesses to operate in; address cross border data flows to ease doing business and encourage innovation; and other topics to be decided by the participating entities.

Employ AI tools in social listening applications to enhance citizen-government engagement, social cohesion, and disaster and other humanitarian relief efforts

Governments and humanitarian organizations are increasingly using AI-driven analysis and other kinds of AI applications to understand real-time citizen needs. Social listening in this context is defined as AI-enabled analysis of text, audio, social media and other data to understand real-time citizen needs. Through the processing of vast amounts of public data, social listening tools enhance governance, crisis response and public service delivery. In the Arab region, over 90 per cent of young people use social media daily, and Facebook alone has 190 million active users. During crises, AI-powered analysis of social media can provide faster insights than official reports. This can help authorities to respond quickly to public concerns and emerging risks.[145]

Around the world, AI and other digital platforms and tools that facilitate public participation in various aspects of governance decision-making and humanitarian operations are already in use. To integrate social listening into governance, Governments should implement programmes and actions for structured use of AI tools to analyse public digital conversations, detect patterns, and translate insights into policy actions, not only in crisis response but also in everyday governance contexts. Governments can set up monitoring units to work with humanitarian groups, local authorities and social media platforms to track public sentiment and help detect misinformation. AI-powered surveys can gather insights beyond analysing social media users. Voice-based surveys can reach populations with lower literacy levels. Aligning this approach with SDG 11 and SDG 16 would strengthen governance and resilience.

The use of AI for social listening and related decision-making has already shown results, for example to detect linguistic patterns in people reporting in real-time during the 2022 floods in Pakistan. For non-crisis contexts, digital citizen engagement tools in use in some countries in the Arab region today could be adapted by other countries with only marginal costs, which could be covered through collaboration with multilateral institutions or private sector partnerships. Efforts to introduce the use of AI in humanitarian or government operations and activities must build in measures to protect the rights and safety of the populations being served. Use cases of AI in these contexts may pose risks. These include potentially "exacerbating disproportionate surveillance, perpetuating inequalities due to algorithmic biases", or technical failures in newly introduced systems leading to inadvertent delays, disruption or cancellation of aid distribution.[146]

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Capacity-building

An estimated **60 per cent** of jobs in advanced **economies** already are or will be **exposed to AI**. Some workers will be displaced by AI in occupations where tasks can be automated, while other jobs will instead be complemented by AI that increases workers' productivity.

A. The urgent need for AI capacity-building

AI is actively reshaping every sector, and its power to do so is growing exponentially. The need for capacity-building is both essential and urgent. To not be left behind, industries and Governments must develop essential workforce capabilities, infrastructure and policies. In the Arab region, existing skills, technology infrastructure and governance frameworks need to be developed to enable the transformation.[147]

AI will have substantial impacts on jobs and employment. Some of these are already being seen, and the projected future impacts are more complex than the equation of current jobs eliminated and new jobs created. An estimated 60 per cent of jobs in advanced economies already are or will be exposed to AI. Some workers will be displaced by AI in occupations where tasks can be automated, while other jobs will instead be complemented by AI that increases workers' productivity.[148]

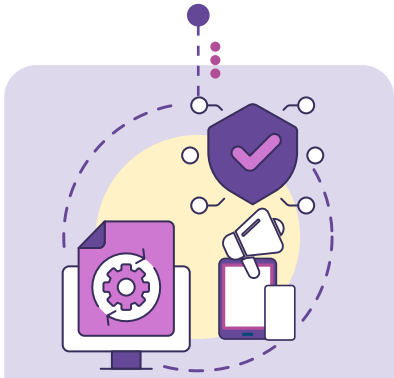
Countries in the Arab region must focus on AI capacity-building – skills, infrastructure and governance institutions – as both an enablement mechanism and a protective mechanism for the millions of the workers that comprise their economies and societies. Education and training will be critical to qualify people for the increasingly AI-centric jobs of the future, and for requalifying others for new jobs when their current ones are displaced by AI. Creation of data centres, networks and other AI infrastructure will create jobs, and training for those jobs will be needed. New regulatory and other institutions will provide the capacity for workers to contend with the social, economic, health and other challenges they will face as AI changes the future of industries.

B. New jobs, gone jobs and changed jobs as AI advances

AI is not the first instance of technology impacting jobs. Examples point to the positive impacts of technology innovations on employment, and also to the importance of deliberate efforts to reskill workforces and to put regulatory measures in place to help workers contend with new technologies.

1. AI is not the first wave of technology impacting jobs

The emergence of the Internet, personal computing, enterprise computing and smartphones have revolutionized work environments and reshaped employment across multiple sectors. They enable real-time communication through email and instant messaging and real-time data sharing within and between businesses, bridging geographical divides and enhancing team collaboration. E-commerce has revolutionized the retail sector, allowing businesses to operate without a physical presence. However, these shifts also contribute to job outsourcing, decline in traditional retail employment, and a growing dependence on precarious gig work arrangements.[149]

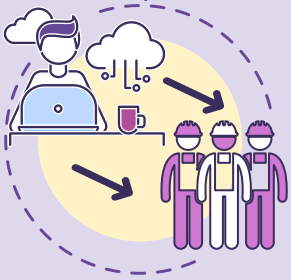


The Internet has given rise to new job roles like **web developers, digital marketers, cybersecurity** experts and e-commerce specialists. The digital economy of China supported **256 million jobs** in 2022, a **15 per cent** rise from the previous year.

The Internet has given rise to new job roles like web developers, digital marketers, cybersecurity experts and e-commerce specialists. The digital economy of China supported 256 million jobs in 2022, a 15 per cent rise from the previous year. However, while these new roles have benefited skilled professionals, they have also widened the income gap, leaving many middle- and low-skilled workers with fewer opportunities. ICT disproportionately affects middle-skilled jobs and leads to job polarization. Higher investment in these technologies leads to a greater increase in high-skilled labour's share of labour income and a decrease in the middle-skilled labour's share. The transition to digital work often requires retraining, which can be costly and inaccessible to those already displaced by automation.[150]

The smartphone revolution has transformed employment by creating opportunities, for example by supporting the emergence of a vast ecosystem of mobile apps. The rise of social media has also driven new career paths, with digital marketing becoming an essential business strategy for engagement and audience targeting. Yet many of these roles lack stability, benefits and worker protections, raising concerns about the quality of jobs being created in the digital age. Additionally, increased connectivity from smartphones and mobile computers has blurred the boundaries between work and personal life. A decade ago, 77 per cent of employees in remote and freelance positions reported experiencing mental health challenges and burnout due to increased work expectations and difficulty disconnecting from their jobs.[151]

These and other lessons learned from the impacts of previous waves of technology innovation must inform how leaders in the Arab region approach capacity-building to prepare countries' workforces for the job realities of the AI future.

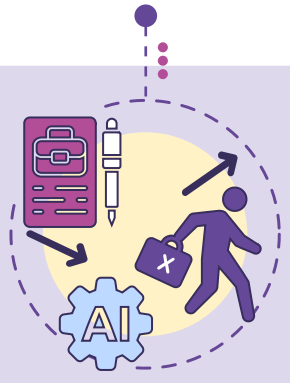


Generative AI and automation could affect up to **70 per cent of employees'** current work activities, necessitating career transitions for approximately **12 million workers** across Europe and the United States.

2. AI will likely be the most profound, with job losses and gains already being seen

Unlike previous automation waves that primarily impacted low-skilled jobs, the expanding capabilities of AI now extend into high-skilled, white-collar professions, affecting fields such as business, science, engineering, law and the arts. AI-driven transformations are expected to reshape job structures, increasing demand for high-skilled professionals in sectors such as healthcare and cybersecurity. It also will reduce opportunities in office administration, manufacturing and customer service. Generative AI and automation could affect up to 70 per cent of employees' current work activities, necessitating career transitions for approximately 12 million workers across Europe and the United States. However, these estimates do not account for potential economic shocks, workforce readiness or disparities in AI adoption across industries. Lower-wage workers are particularly vulnerable, requiring urgent reskilling efforts to remain competitive. Existing retraining initiatives, such as online AI career certifications and government-led programmes, may not scale sufficiently to meet demand, necessitating stronger collaboration between policymakers, industries and educational institutions.[152,153]

An estimated 83 million jobs will be lost globally as a result of AI, even as 69 million new jobs are created. Generative AI has the potential to automate up to 300 million full-time jobs in Europe and the United States, and impacts like this can be anticipated in Arab region countries, commensurate with the size and nature of job markets. In 2025, 60 per cent of employers reported anticipating major workforce restructuring by 2030. Advancements in AI and information processing are projected to simultaneously drive job creation and displacement in 86 per cent of employers surveyed. Robotics and autonomous systems, many AI-enabled, are expected to be the largest net job displacers, eliminating 5 million jobs. Over the 2025–2030 period, structural labour market shifts driven by AI are projected to result in a net creation of 78 million jobs, offsetting 92 million job displacements. However, these projections depend on multiple factors, including government policies, pace of AI adoption, labour market regulations and macroeconomic conditions.[154]



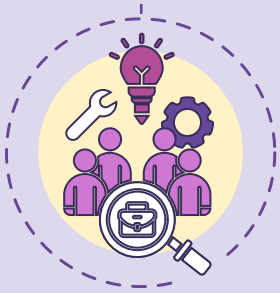
An estimated **83 million jobs** will be lost globally as a result of AI, even as **69 million new jobs** are created.

3. Changed jobs through AI-driven skill disruption

The impacts of AI on employment demand not only adjusting to job creation and elimination, but also equipping individuals with the skills to work alongside AI systems. Success in AI integration depends as much on people as on the technology itself. The most critical skills from 2025 to 2030 will be the ability to leverage big data and AI in current but changed job roles. Technological advancements are expected to be the primary driver of skill evolution over that period, as a projected 39 per cent of today's skills evolve or become obsolete.[155]

The impact of AI on employment and skill needs will not be uniform across regions. Developed economies are more likely to experience disruptions in knowledge-based professions, while developing economies, where labour costs are lower and AI adoption is slower, may initially see a less pronounced shift. The effects of AI will vary significantly by sector.

For example, in healthcare, AI-assisted diagnoses, surgeries and telemedicine will augment medical professionals rather than replace them. Building the governance



The impact of AI is also influencing **hiring strategies**. Skill gaps remain the most significant barrier to business transformation, with **63 per cent of employers** identifying this as a top challenge between **2025 and 2030**. In response, **85 per cent of employers** plan to invest in workforce upskilling, while **70 per cent intend to hire talent** with new skills.

capacity to manage this transition within healthcare institutions will be essential. In education, AI-driven personalized learning tools will reshape the role of educators from traditional teaching to AI-augmented mentorship. Successful AI integration into education will require substantial investment in teacher training to ensure that educators can effectively incorporate AI tools into their methods. Administrators will also need to develop AI literacy to make data-driven decisions in educational institutions. In many industries, AI-powered automation is expected to replace low-skill manual labour while creating demand for robotics engineers and automation specialists. AI will enhance production planning and control, quality management, maintenance management and supply chain management. It will also reshape workforce demands, requiring professionals to develop AI-driven problem-solving skills and adapt to AI-enhanced environments.[156]

The impact of AI is also influencing hiring strategies. Skill gaps remain the most significant barrier to business transformation, with 63 per cent of employers identifying this as a top challenge between 2025 and 2030. In response, 85 per cent of employers plan to invest in workforce upskilling, while 70 per cent intend to hire talent with new skills. Nearly 50 per cent anticipate transitioning employees from declining roles to emerging ones, and 40 per cent expect workforce reductions as some skills become obsolete. These shifts are already being seen as AI chatbots and automation reduce the demand for entry-level roles while increasing the need for AI data analysis expertise.[157]

C. How AI jobs are evolving in selected Arab region countries

The impacts of AI on jobs in the GCC countries, where the technology is being adopted most quickly, provide an example of what leaders can expect in other Arab region countries.

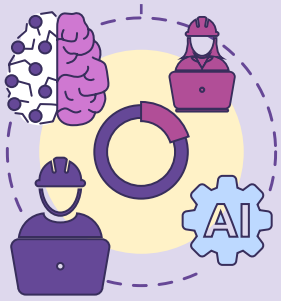
In Saudi Arabia, AI is projected to augment and automate nearly one-third of all jobs, significantly transforming productivity, agility and collaboration, particularly in high-skilled professions. Generative AI is expected to impact 37 per cent of all hours worked, offering opportunities for revenue-generating activities and higher-value contributions. However, nearly half of all jobs in the country remain predominantly non-language-based, limiting exposure to AI-driven disruption in the short term. As Saudi Arabia advances toward a knowledge-based economy under its Vision 2030, the prevalence of language-intensive roles is expected to rise, accelerating AI adoption.[158]

Highly-skilled occupations (25 per cent of total employment in Saudi Arabia) are projected to undergo significant transformation. Generative AI could automate and augment over half of working hours in these roles, with an additional third being substantially impacted. Professions such as mining, engineering and metallurgy, which involve scheduling operations, system testing and model development, stand to benefit from AI-driven efficiencies. Within organizations, functions such as finance, IT and operations exhibit the highest potential for AI augmentation and automation.[159]

In the United Arab Emirates, certain job market sectors are expected to witness a gradual transition, with AI increasingly automating manual roles, particularly those centred on documentation and process-driven tasks. Fintech and technology-driven firms are likely to follow the lead of developed markets, such as that of Sweden,

which is increasing use of AI to streamline back-office operations. In parallel, the emergence of highly skilled AI-driven roles is gaining momentum, particularly as Abu Dhabi strengthens its position as a global hub for AI investment and development. This trend is expected to generate job opportunities in AI infrastructure development and other areas. For example, the demand for technology-skilled healthcare professionals is set to rise, driven by AI advancements and evolving healthcare needs. Additionally, industries like marketing, advertising, public relations and digital marketing are emerging as key employment sectors for recent graduates.[160]

AI is expected to contribute $5 billion to the economy in Qatar and create 13,000 new jobs by 2030. The Government's $2.47 billion investment in digital infrastructure is driving opportunities for tech professionals, particularly in AI, cloud computing and data management. Organizations are seeking professionals with AI expertise, data analytics skills and innovative problem-solving capabilities. While AI will automate certain tasks of lesser skilled workers and is expected to displace many of them, it is also generating demand for specialized roles such as AI engineers, data scientists, and AI trainers, suggesting a net positive impact of AI on job creation.[161]



In 2024, the labour force participation rate in the Arab region stood at **49 per cent,** but only **19 per cent** of women were part of the workforce compared to **74 per cent of men**.

D. AI jobs against the realities of overall jobs

As AI adoption is rapidly transforming the employment landscape across the Arab region, the realities of unemployment, underemployment and opportunity disparities bring the need for AI skill development and other elements of AI capacity-building into sharp focus.

The region continues to struggle with deep-rooted gender disparities in workforce participation. In 2024, the labour force participation rate in the Arab region stood at 49 per cent, but only 19 per cent of women were part of the workforce compared to 74 per cent of men. The growth of AI-driven job markets will bring with it the challenge of how to build skill capacity to avoid mirroring this underrepresentation in AI fields and in the industries that become reliant on AI. Women are already significantly underrepresented in these roles. Some economies have implemented policies to improve gender inclusivity in tech, but barriers persist, particularly in access to science, technology, engineering and mathematics education and professional networks, leaving women with higher tech sector unemployment rates (17 per cent) than men (8 per cent).[162]

Youth unemployment and unemployment among the educated also remain pressing issues in the Arab region. More than half of the population across the region are below 30 years of age, and young people account for 40 per cent of the unemployed workforce. The Arab region has the highest global rates of unemployment of young people and the educated. Youth unemployment is exacerbated by the growing disconnect between academic curricula and labour market demands. Despite high enrolment rates in higher education, unemployment rates increase with higher education levels, as many graduates lack the technical skills and competencies sought by employers, particularly in high-growth sectors such as AI, cybersecurity and fintech.[163]

Another labour market consideration frames the importance of capacity-building efforts to prepare workforces in the Arab region with the skills they need for the AI economy. The rate of people not in employment, education or training in the Arab region reached 33 per cent in 2024, the highest globally. Young women are disproportionately affected, with 46 per cent classified as not in employment,

Young women are disproportionately affected, with **46 per cent** classified as not in employment, **education** or training compared to **21 per cent** of young men.

education or training compared to 21 per cent of young men. The issue is more pronounced in non-GCC economies (39 per cent), where structural unemployment and economic stagnation exacerbate job shortages.[164]

1. Basic skills and workforce readiness gaps rooted in local education systems

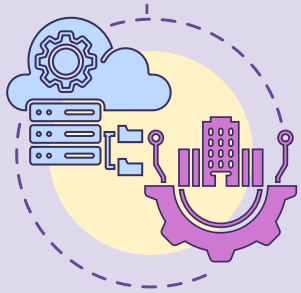
The region also grapples with basic skill gaps that slow AI adoption. Many universities continue to emphasize theoretical knowledge over applied skills, leaving graduates struggling to transition into a workforce increasingly looking for the skills to apply AI and other technologies in practical contexts. Education systems remain out of sync with market demands, not offering hands-on experience with programming and machine learning. Vocational training programmes are also outdated in their ability to equip students with in-demand AI skills such as natural language processing, deep learning, generative AI and AI-driven automation. A lack of AI apprenticeships, micro-credential programmes, and industry-academic partnerships aggravates this. In some cases, companies seeking to implement AI-driven solutions rely on foreign expertise. These challenges are more pronounced in non-GCC countries, where resource constraints create greater barriers for educational institutions seeking to develop cutting-edge AI training programmes.[165]

2. Capacity-building for AI skills is beginning to advance

As skill disruption is becoming increasingly evident, workforce capacity-building efforts are beginning to be seen, at least in the countries most quickly adopting AI.

For example, the United Arab Emirates National AI Strategy 2031 has led to the development of specialized AI literacy programmes, including the United Arab Emirates AI Camp, which trains students and professionals in AI applications, and training initiatives at AI-dedicated Mohammed bin Zayed University of Artificial Intelligence. The United Arab Emirates partnership with Microsoft aims to equip one million individuals with AI skills by 2027. The Saudi Authority for Data and Artificial Intelligence has launched AI-focused training partnerships with Google, IBM and Huawei, aiming to upskill thousands of professionals annually. Under its National Strategy for Data and Artificial Intelligence, Saudi Arabia aims to train 20,000 AI and data specialists by 2030. At the academic level, 86 per cent of universities are offering AI-related undergraduate programmes and government-backed AI academies are upskilling thousands of professionals.[166]

Egypt has also taken steps to expand AI education. The Digital Egypt Builders Initiative has been launched in collaboration with the Massachusetts Institute of Technology and Coursera, offering specialized AI training and AI data science certifications to university graduates. Bahrain Polytechnic has introduced AI courses, aligning with the country's broader digital transformation plans. The Mohammed VI Polytechnic University in Morocco is focusing on AI education as well as research, positioning itself as a hub for AI development in North Africa. Overall, region-wide, progress remains uneven and many low-income and middle-income countries lack the resources to implement comprehensive AI skill development capacity-building strategies for their workforces.



As AI adoption accelerates in the Arab region, workforce readiness needs are not the only capacity-building imperatives. There are also **governance structure** and **infrastructure** needs, which must be urgently addressed to enable the region to leverage the full potential of AI.

E. Other key elements of AI capacity-building in the Arab region

As AI adoption accelerates in the Arab region, workforce readiness needs are not the only capacity-building imperatives. There are also governance structure and infrastructure needs, which must be urgently addressed to enable the region to leverage the full potential of AI. Skill education programmes, governance and regulatory frameworks, and infrastructure development for AI in the Arab region represent an intersection between technology, policy and industry. Investments in all three of these elements of AI capacity-building will shaping the role of AI in regional economies, influencing labour markets, innovation ecosystems and digital transformation efforts.[167]

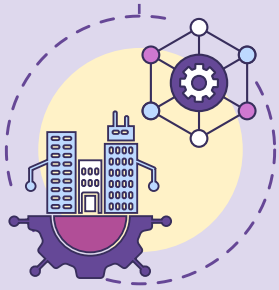
Just as there are barriers to the development of AI-related workforce skills faces, such as labour market disparities and the mismatch of education systems to industries' needs, there are also obstacles regarding the Arab region's AI-relevant infrastructure and governance mechanisms.

1. Computing resources and other research and development limitations need attention

One of the most pressing capacity-building demands in the Arab region is insufficiencies in high-performance computing resources and AI-optimized data centres. While some GCC countries like Saudi Arabia and the United Arab Emirates have invested substantially in cloud computing and AI-specific infrastructure, regional supply still trails demand by 40 per cent. AI workloads – particularly in machine learning training and inference tasks – require substantial computing power, yet data centres in the region often lack the specialized hardware to support large-scale AI applications.

A significant bottleneck in infrastructure expansion is the shortage of AI chips, with procurement times in the region averaging two years, delaying the deployment of AI-powered solutions. Non-GCC countries face even greater challenges, as many lack basic cloud computing capabilities to support AI model training and deployment. The divide between well-funded AI hubs and lower-income countries raises concerns about economic polarization, as wealthier countries leverage AI for productivity gains while others struggle to integrate even foundational AI technologies. Without significant capacity-building efforts to enhance AI computing resources and make cloud-based AI services accessible, these disparities are likely to deepen.[168]

The Arab region also lags behind in other forms of critical AI research infrastructure, patent generation and model development. Compared to global AI hubs, Arab region countries produce far fewer AI research papers and patents. Many of the AI models and applications used in the region are imported from foreign tech firms, rather than being developed domestically. This is due in large part to limitations in relevant laboratory capacity and lack of the tools needed in AI research and development. Despite investment in AI-focused academic programmes and research institutions in some countries in the region, most have yet to establish a robust AI research and development ecosystem that fosters innovation. The relative lack of government-backed AI research infrastructure – not just buildings and equipment, but also grants, industry-academic partnerships and AI startup incubators – has resulted in



Nearly **50 per cent** of chief executive officers in the Arab region recently identified building this **infrastructure** as an essential focus for reaching **AI goals** between now and **2030**.

limited homegrown AI solutions. Without stronger capacity-building investment in AI research and development infrastructure, countries in the Arab region are at risk of remaining consumers of AI technologies rather than active contributors to the global AI economy.

Nearly 50 per cent of chief executive officers in the Arab region recently identified building this infrastructure as an essential focus for reaching AI goals between now and 2030.[169] Some countries are implementing actions. In August 2024, the United Arab Emirates Government partnered with Microsoft for two new joint AI centres in Abu Dhabi. Saudi Arabia partnered with United States-based semiconductor startup Groq in September 2024. Saudi Arabia aims to create the largest data centre specialized in AI processing in the world. In October 2024, the Saudi Public Investment Fund and Google Cloud declared a strategic partnership for a Public Investment Fund-funded cutting-edge data centre to be operated by Google. Bahrain, Kuwait, Oman and Qatar aim to make similar deals with global tech industry firms. Similar capacity-building in other countries will be essential as the region moves into the future.

2. AI governance and ethical oversight challenges

The lack of a unified AI governance framework is another barrier to adoption in Arab region countries. Unlike the European Union, for example, which has a risk-based regulation model, the Arab region lacks standardized AI policies, leading to inconsistencies across countries. This creates challenges for businesses operating across the region, as each country has different guidelines on privacy, AI-driven decision-making and AI ethics. The absence of standardized data-sharing agreements also limits AI development. AI models require large, diverse datasets for training, but current data localization laws in various countries in the Arab region restrict cross-border AI collaboration. Without harmonized AI policies and regional cooperation, AI innovation in the region will remain fragmented, limiting its ability to compete with global AI leaders.[170]

Governments and industry leaders globally are implementing AI governance initiatives that could serve as models for countries in the Arab region, tailored to their unique circumstances and priorities. For example, in addition to the European Union AI Act, which focuses on risk-based AI regulation and transparency, the United States Government recently introduced an AI Bill of Rights establishing principles for safe and ethical AI use. Also in the United States, the Institute of Electrical and Electronics Engineers, a non-profit professional association, introduced a set of ethical AI guidelines outlining industry standards for responsible AI development. Bias in AI decision-making, misuse of AI-powered surveillance and a lack of algorithmic transparency are some of the concerns that can be addressed through capacity-building in governance and regulatory frameworks and institutions.[171]

AI governance capacity-building is beginning to gain traction in the region. For example, the Dubai International Financial Centre has implemented AI principles to regulate AI ethics and usage in financial services. Saudi Arabia has developed an AI ethics framework, emphasizing responsible AI practices, while Egypt has engaged in discussions on AI regulations to address concerns around bias and transparency.[172]

While some industries in the Arab region are rapidly integrating AI-driven solutions, others remain slow to adopt AI due to regulatory as well as financial or workforce

To fully capitalize on AI in the Arab region, it is essential to implement a comprehensive policy **framework** that addresses existing deficiencies in AI-relevant **education**, **infrastructure** and **governance**, all supporting innovation, inclusivity, trust, security and other societal imperatives.

constraints. For example, in healthcare, AI applications such as medical imaging diagnostics, robotic-assisted surgeries and AI-driven patient monitoring could revolutionize the sector, but strict regulatory requirements, alongside the shortage of AI-trained healthcare professionals, have slowed adoption. Similarly, in energy and oil and gas industries, AI-powered predictive maintenance and operational optimization could enhance efficiency, but investment in AI-driven solutions remains limited beyond a few pilot projects, in part due to a policy and regulatory environment that does not adequately incentivize innovation. Most countries in the Arab region lack the policy and governance framework support necessary to build AI-driven economies. Slow movement in this element of AI capacity-building could reinforcing economic disparities and delaying the region's overall AI transformation.

F. A policy framework for AI capacity-building in the Arab region

To fully capitalize on AI in the Arab region, it is essential to implement a comprehensive policy framework that addresses existing deficiencies in AI-relevant education, infrastructure and governance, all supporting innovation, inclusivity, trust, security and other societal imperatives. Such a framework should comprise the following set of strategic pillars aimed at building robust AI capacity, driving sustainable economic growth, and ensuring equitable technological advancement for all.

1. Academic and educational development

- Curriculum enhancement: Integrate AI-focused curricula across all educational levels, emphasizing practical applications to prepare students for the evolving job market. This includes developing modules that cover machine learning, data analytics and AI ethics, ensuring students gain hands-on experience through projects and laboratory work.
- Industry-aligned programmes: Collaborate with private companies and startups to co-develop dynamic AI courses, ensuring alignment with current market demands. Establish advisory boards comprising industry experts to regularly update curricula, reflecting the latest technological advancements and industry requirements.
- Multidisciplinary integration: Introduce programmes that combine AI with sectors such as healthcare, agriculture and logistics, addressing regional priorities. For example, develop courses that explore AI applications in precision farming, medical diagnostics and supply chain optimization, fostering innovation at the intersection of disciplines.
- Experiential learning: Provide access to high-performance computing infrastructure and AI laboratories for hands-on training. Establish partnerships with tech companies to equip institutions with state-of-the-art tools, enabling students to work on real-world datasets and scenarios.
- Inclusive scholarships and fellowships: Offer financial support to underrepresented groups, including women and rural communities, to promote equitable access to AI education. Implement outreach programmes to identify and mentor talented individuals from diverse backgrounds, ensuring inclusivity in AI talent development.

2. Talent development and workforce upskilling

- Accessible learning: Develop flexible online and hybrid courses in partnership with global platforms to make AI education accessible for working professionals. Leverage massive open online courses and virtual classrooms to reach a wider audience, accommodating various learning paces and schedules.
- Workforce training: Encourage government and private sector partnerships to offer AI-specific training for professionals in key industries. Design workshops and certification programmes that address sector-specific AI applications, enhancing productivity and innovation.
- On-the-job training: Incentivize companies to provide apprenticeships and internships to build practical AI skills. Develop frameworks for industry-academia collaboration, allowing students to gain hands-on experience while contributing to organizational projects.
- Lifelong learning: Ensure continuous education opportunities to help the existing workforce adapt to the rapidly evolving AI landscape. Promote a culture of lifelong learning by offering micro-credentials and short courses that enable professionals to update their skills regularly.

3. Digital infrastructure and computational capacity

- Connectivity expansion: Expand broadband access, particularly in underserved areas, to reduce the digital divide and ensure equitable access to AI tools and resources. Implement national initiatives to enhance Internet penetration to facilitate remote learning and inclusion.
- Computing power: Establish regional data centres to provide the necessary computational capacity while maintaining data sovereignty. Invest in scalable cloud infrastructure that supports AI research and development, offering resources to startups and academic institutions.
- Green energy solutions: Support green energy initiatives to power AI systems sustainably, reducing environmental impacts while maintaining computational efficiency. Encourage the adoption of energy-efficient hardware and promote research into low-power AI algorithms.

4. AI research and innovation

- Research and development initiatives: Launch joint research initiatives between private companies, academia and Governments. Establish research consortia focused on addressing regional challenges through AI, such as water scarcity, healthcare access and renewable energy.
- Collaborative regional research: Fund regional research on topics like gender bias, linguistic diversity and cultural representation in AI. Create platforms for knowledge exchange and collaborative projects that reflect the Arab region's unique social and cultural contexts.
- Open-source platforms: Develop open-source AI platforms to enable affordable and scalable adoption by startups, SMEs and research institutions. Promote the sharing of code repositories and tools to accelerate innovation and lower entry barriers.
- Data-sharing platforms: Establish a regional data-sharing platform to aggregate high-quality, diverse datasets for AI applications. Ensure data governance frameworks are in place to protect privacy and promote ethical data usage.

5. AI governance and regulation

- Comprehensive policies: Draft policies addressing AI challenges including data privacy, algorithmic transparency, intellectual property and ethics to ensure AI deployment aligns with societal values and legal standards. Make these policies adaptable to evolving technologies.
- Policy alignment: Coordinate policies across countries on gender equity, bias mitigation and cultural sensitivity. Establish regional committees to harmonize regulations and promote best practices in AI governance, ensuring a unified approach to ethical AI deployment.
- Regulatory training: Train policymakers and regulators on AI risks and opportunities to ensure informed decision-making. Conduct workshops and seminars to build capacity in understanding AI technologies and their societal implications, fostering a regulatory environment that supports innovation while safeguarding public interests.
- Regulatory sandboxes: Create environments to test innovative AI solutions in critical sectors without imposing full regulatory constraints. These sandboxes will allow for experimentation under controlled conditions, enabling the assessment of new technologies' impact and feasibility before widespread implementation.
- International partnerships: Collaborate with organizations and institutions to align governance frameworks with global best practices while respecting regional contexts. Engage in international dialogues to stay abreast of emerging trends and standards in AI ethics and regulation, ensuring that regional policies are informed by global experiences.

6. AI ethics and bias detection

- Ethical certification: Implement programmes and guidelines to ensure AI systems align with regional cultural and legal norms. Develop certification processes that assess AI applications for ethical compliance and societal impact, promoting public trust in AI.
- Ethics councils: Establish national and regional councils to ensure alignment with cultural, social and legal norms while harmonizing governance standards. These councils should include diverse stakeholders, including ethicists, technologists and community representatives, to provide comprehensive oversight of AI initiatives.
- Bias monitoring: Develop policies for monitoring and mitigating algorithmic bias. Implement auditing mechanisms to evaluate AI systems for fairness and inclusivity, ensuring they do not perpetuate discrimination or reinforce existing inequalities.
- Accountability mechanisms: Require organizations to publish reports on how they address bias in AI applications. Foster accountability through transparency in these processes and public scrutiny, encouraging continuous improvement in AI system design and deployment.

7. Innovation ecosystems and entrepreneurship

- Startup support: Launch incubators and accelerators to support early-stage AI startups and SMEs with funding, mentorship and access to cutting-edge tools and technologies. These initiatives can stimulate innovation and drive economic growth by nurturing new ideas and facilitating their transition into viable products and services.
- Public-private partnerships: Promote collaborations to foster AI innovation in key industries, focusing on sectors critical to regional economies. Such partnerships can leverage the strengths of both public and private sectors, combining resources and expertise to tackle complex challenges and develop impactful AI solutions.
- Industry-academia collaboration: Foster partnerships to drive applied AI research on regional challenges. Encourage joint projects that bring together academic researchers and industry practitioners to develop practical solutions aligned with real-world needs.
- Regional collaboration: Establish a regional AI research fund to finance innovation and cross-border projects. This fund can support collaborative initiatives that address shared challenges, promote knowledge exchange, and strengthen collective AI capabilities.

8. AI literacy, public awareness and trust building

- Literacy campaigns: Conduct public campaigns to address misconceptions and build trust in AI applications. Campaigns should provide clear and accurate information about AI technologies' benefits and potential risks, helping demystify AI and alleviate public concerns.
- Localized outreach: Use regional dialects and culturally relevant examples to highlight the role of AI in solving local issues. Tailoring communication strategies to resonate with diverse audiences can enhance understanding and acceptance of AI across different communities.
- Governance education: Launch initiatives to educate the public about safeguards in place to protect their rights and ensure ethical AI use. Transparency about regulatory frameworks and ethical guidelines can foster public confidence in AI systems and their governance.
- Community engagement: Organize forums to educate citizens on the societal benefits of AI while addressing

concerns about job displacement and privacy risks. Engaging directly with communities allows for open dialogue, enabling stakeholders to voice their concerns and contribute to shaping AI policies that reflect societal values.

- Inclusive design: Ensure AI solutions are designed to serve all demographic groups, including those with limited technical literacy. Inclusive design principles ensure that AI tools are accessible and beneficial to all, promoting equity in the distribution of their advantages.

9. Cybersecurity and AI safety

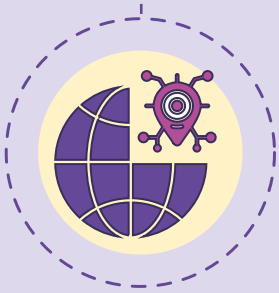
- National frameworks: Develop comprehensive cybersecurity frameworks tailored to AI applications, addressing data privacy, adversarial attacks and system vulnerabilities. These frameworks should establish standards and best practices for securing AI systems against emerging threats, ensuring their safe and reliable operation.
- Training programmes: Equip AI professionals with the skills to secure systems against emerging threats. Offer specialized training programmes on topics such as secure coding practices, threat modelling and incident response, building a workforce for maintaining robust AI security.
- Global collaborations: Partner internationally to access the latest cybersecurity tools and practices. Global collaborations allow for the sharing of knowledge and resources, and will enhance the Arab region's capacity to protect AI systems against sophisticated threats.
- Regional task forces: Establish collaborative efforts across countries to share best practices, monitor threats, and respond to emerging risks. Task forces can facilitate real-time information exchange and coordinated responses to incidents affecting AI systems.

10. Funding and resource mobilization

- National budgets: Allocate specific budgets for AI capacity-building, ensuring sustained investment in education, infrastructure and research initiatives. Governments should prioritize funding for AI projects that align with national development and national vision goals and that have the potential for significant societal impact.
- International funding: Seek grants and investment from international organizations and development agencies to support AI initiatives. Engaging with global funding bodies can provide resources and foster partnerships that will enhance the region's AI capabilities.
- Private sector engagement: Encourage private sector investment in AI through incentives such as tax breaks, grants and public recognition. Creating a favourable investment climate can stimulate corporate contributions to AI development and application.
- Public-private partnerships: Foster collaborations between government entities and private companies to pool resources for large-scale AI projects. These partnerships can leverage the strengths of both sectors to drive innovation and address complex challenges.

11. Gender inclusivity in AI

- Representation in decision-making: Ensure that women and underrepresented groups are included in governance councils and policymaking bodies. This inclusion will foster diverse perspectives, leading to more comprehensive and equitable AI policies.
- Policies for equitable AI: Draft regulations that promote gender equity in AI development and deployment. Policies should mandate rigorous consideration of gender and intersectional impacts throughout the entire AI system's lifecycle, design to development to governance. Such frameworks ensure marginalized communities, particularly women and gender minorities, are involved in shaping AI initiatives' priorities, processes and outcomes.
- Gender-equity in workplace policies: Encourage organizations to adopt gender-equity policies, such as equal pay, flexible work arrangements and anti-harassment policies. These measures create an inclusive work environment that attracts and retains diverse talent, essential for innovative AI development.
- Diversity in AI teams: Promote gender diversity in AI development teams to minimize unconscious biases in system design. A diverse team is more likely to identify and address potential biases, leading to fairer AI outcomes.
- Incentives for private sector engagement: Provide tax incentives or grants to companies that achieve gender equity targets in their AI teams. This approach encourages the private sector to prioritize diversity and inclusion, contributing to a more balanced AI workforce.
- Training programmes: Integrate gender bias awareness into AI education and training programmes, in both academic institutions and industry. Educating stakeholders about the implications of gender bias in AI fosters the development of more equitable technologies.
- Workshops for developers: Conduct workshops for AI developers on designing algorithms that actively mitigate gender bias in datasets and decision-making. These workshops can provide practical tools and methodologies to identify and reduce bias in AI systems.



A phased and tiered strategy for **AI capacity-building** can be designed to be both adaptive and inclusive, ensuring that each country can progress according to its unique circumstances while benefiting from **regional collaboration.**

12. Linguistic and cultural representation in AI

- Culturally representative AI: Ensure that governance frameworks promote the creation of AI systems that reflect the multilingual and multicultural diversity of the Arab region, making them relevant and equitable for all populations. This involves developing AI that recognizes and respects local contexts and cultural nuances.
- Dialect-specific natural language processing research: Invest in natural language processing research focusing on regional Arabic dialects and minority languages.
- Diverse datasets: Partner with linguists and cultural experts to create datasets representing the full diversity of the Arab region, including culture, gender, ethnicity, socioeconomic status and geography. Diverse datasets are key for training AI systems that are fair and unbiased.

G. A phased and tiered approach

The Arab region is a mosaic of cultural, economic and technological landscapes, each country presenting unique strengths and challenges in the realm of AI. The United Arab Emirates and Saudi Arabia have made significant investments in AI infrastructure and research. Other countries in the region are at earlier stages of AI adoption, facing challenges such as limited digital infrastructure, skill gaps and data privacy concerns. These disparities necessitate a phased and tiered strategy for AI capacity-building, tailored to each nation's specific context. By fostering collaboration, more advanced countries can share knowledge, resources and best practices with those in earlier stages, ensuring that all countries in the region can participate in and benefit from the AI-driven future. A phased and tiered strategy for AI capacity-building can be designed to be both adaptive and inclusive, ensuring that each country can progress according to its unique circumstances while benefiting from regional collaboration.

Phase 1 – Short term: Focus on establishing foundational infrastructure and basic governance frameworks, initiating public awareness campaigns, and fostering grassroots innovation.

- Foundational infrastructure: Develop essential digital infrastructure, including high-speed Internet access and data centres, to support AI initiatives.
- Governance frameworks: Establish regulatory bodies and policies to oversee AI development and ensure ethical practices.
- Public awareness: Launch campaigns to educate the public on the benefits and potential of AI, encouraging acceptance and engagement.
- Grassroots innovation: Support local startups and innovators through funding and mentorship programs to stimulate AI solutions addressing regional challenges.

Phase 2 – Medium term: Aim to strengthen talent pipelines, develop regional data ecosystems, implement robust cybersecurity measures, and enhance regional collaboration.

- Talent development: Invest in education and training programmes to cultivate a skilled AI workforce.
- Data ecosystems: Create shared data platforms to facilitate research and development across borders.
- Cybersecurity: Implement measures to protect data integrity and build trust in AI systems.

- Regional collaboration: Foster partnerships among countries in the Arab region to share knowledge, resources and best practices.

Phase 3 – Long term: Focus on scaling AI research hubs, establishing cross-border partnerships, and integrating AI into both traditional and emerging industries.

- AI research hubs: Develop centres of excellence to drive innovation and attract global talent.
- Cross-border partnerships: Collaborate with international entities to grow AI market reach.
- Industry integration: Embed AI solutions into sectors like healthcare, agriculture and finance to boost efficiency and productivity.

Tier – Higher-income countries: Concentrate on advanced AI research, cloud computing infrastructure and leadership in AI ethics.

- Advanced research: Invest in cutting-edge AI technologies and applications.
- Cloud computing: Develop scalable infrastructure to support large-scale AI operations.
- Ethical leadership: Establish frameworks to guide responsible AI development and use.

Tier – Middle-income countries: Prioritize talent development, affordable infrastructure and empowerment of SMEs.

- Talent development: Enhance educational programmes to build a competent AI workforce.
- Affordable infrastructure: Ensure access to needed tools and platforms for AI development.
- SME empowerment: Support SMEs in adopting AI to improve competitiveness.

Tier – Least developed countries and conflict-affected countries: Leverage regional and global partnerships, utilize open-source AI tools, and implement digital inclusion initiatives.

- Partnerships: Collaborate with neighbouring countries and global organizations to share resources and expertise.
- Open-source tools: Adopt cost-effective AI solutions to overcome budget constraints.
- Digital inclusion: Implement programmes to ensure all communities benefit from AI.

Employment and AI adoption challenges in the Arab region are deeply intertwined. Addressing these issues requires a multi-faceted approach, including workforce reskilling, investment in AI-ready infrastructure, inclusive AI governance and industry-academia partnerships. By adopting a phased and tiered technology-driven policy framework, economies in the region can bridge skill gaps, accelerate AI adoption, and position themselves as global leaders in the digital economy.

H. Metrics and evaluation for AI capacity-building in the Arab region

To effectively monitor and assess the progress of AI capacity-building initiatives in the Arab region, clear metrics and evaluation frameworks must be established. These metrics should be tailored to the phased and tiered strategy, ensuring that each country's unique context is considered. Key performance indicators might include:

1. Infrastructure development

- Digital connectivity: Track the percentage of the population with access to high-speed Internet, aiming for universal coverage.
- Data centre capacity: Measure total data centre capacity (in megawatts) to support AI operations, with targets adjusted for each country's needs.

2. Talent, education and skill development

- AI workforce growth: Monitor the number of professionals trained in AI-related fields, with a focus on annual growth rates.
- Educational programmes: Assess the number and quality of AI-focused educational programmes at universities and technical institutes.

3. Research and innovation

- Published research: Count the number of AI research papers published in reputable journals by institutions within the region.
- Patents: Track the number of AI-related patents filed annually as an indicator of innovation.

4. Industry adoption

- AI integration in businesses: Evaluate the percentage of businesses adopting AI solutions across various sectors.
- SME engagement: Measure the involvement of SMEs in AI initiatives, ensuring inclusivity.

5. Policy and governance

- Regulatory frameworks: Count the number of AI policies and ethical guidelines developed and implemented. Benchmark against global standards, accounting for regional differences.
- Data privacy compliance: Monitor adherence to data privacy regulations for responsible AI.

6. Public awareness and inclusivity

- Awareness campaign reach: Gauge the effectiveness of public awareness campaigns by measuring audience reach and engagement levels.
- Digital inclusion: Track the reduction in the digital divide, focusing on marginalized communities' access to AI benefits.

Regular evaluations using these metrics will provide insights into the effectiveness of AI capacity-building efforts and will allow for timely adjustments to strategies and help ensure that the initiatives lead to sustainable and inclusive growth across the Arab region.

I. Recommendations aligned with capacity-building

Four recommendations were identified that are drawn directly from the twelve-pillar policy framework for AI capacity-building outlined above, and that align with recommendations and analysis outlined in three pathways for AI development in the Arab region outlined in chapters 2, 3 and 4. They are not exclusive in their relevance to the pathways, as they could also be supportive of other pathways that policymakers and other leaders might pursue.

Develop a region-wide interconnected set of programmes to train individuals with the skills needed to work as users and developers of AI throughout the private and public sectors

Substantial numbers of new jobs will be created in the Arab region from the advancement of AI. Even larger numbers of existing jobs will change because AI tools and applications will be integrated into workers' tasks and responsibilities. Millions of people need skills they do not yet possess to use AI in their daily work or to become developers of AI. Governments and other entities in the region are already creating programmes for AI-related skill development. This recommendation proposes an initiative in which these programmes collaborate with one another and also help establish similar programmes in countries that do not yet have them.[173]

Countries with already-established AI skill development programmes could act as regional hubs, hosting training classes and other activities (in person and remotely) for people from other countries. Equitable regional representation should be ensured via quotas for placements in the classes for each country. One focus area for skill building should be technical (AI development and building AI systems, targeting university and institute graduates of computer science, data science, data analytics). A second should be AI use in workplace applications (targeting people already holding jobs, with affirmative action for women and for university-educated men and women not currently in the workforce). A third should be on intermediate digital skills for everyday contexts (with affirmative action for women, young people and informal sector workers).

Alongside hub-hosted training activities, individual country AI skill development initiatives should liaise to share best practices, lessons learned, and curricula and materials. Hubs and individual country programmes should partner with local and multinational corporations; global educational programmes and providers for content and certificates; and with regional entities. Links for job placements should be established between the tech startup sector in Arab region countries, as well as universities and organizations in other sectors, to promote brain retention for programme graduates instead of brain drain from the region.

Implement legislation in Arab region countries to provide safety nets for workers displaced due to AI and to establish fair work conditions for digital freelance and gig labour as it is increasingly impacted by AI

While the expansion of generative AI and language models will create new work opportunities, two negative outcomes are also anticipated: job loss for potentially large numbers of people whose work will be replaced by automation, and freelance digital work that does not offer fair work conditions. With respect to the latter, freelance and gig work is growing everywhere in the world. More than 30 per cent of professionals in Arab region countries are undertaking freelance work, and

freelance registrations increased by around 142 per cent from 2022 to 2023 in a wide variety of sectors of the economy. Many of these workers have seen their roles dramatically impacted since the release of ChatGPT in ways like downward pressure on pay rates due to competition from AI.[174]

Countries in the Arab region should allocate or acquire funding and then design and implement programmes that provide safety nets for workers who lose their jobs to automation. Mechanisms could be in the form of cash transfers conditional on joining training programmes to upskill workers or on starting entrepreneurial activity within a specified period of time. Specific programmes could be established for displaced women workers in countries where they are anticipated to bear the brunt of workplace shocks stemming from AI. Labour laws should be revised to adopt clear definitions of digital freelance and gig work and these workers should be included in national labour market surveys to ensure their proper inclusion in national policymaking. Once these definitions and inclusions are established, labour laws should be further revised to include digital freelance and gig workers in national social protection schemes. Digital platform owners should be incentivized to adopt practices for their workers, following principles of fair pay, conditions, contracts, management and representation.

Models exist that could be looked to for designing safety nets for jobs lost due to AI in Arab region countries. For example, Uzbekistan mandates employers to comply with employment termination mechanisms recommended by the International Labour Organization to provide displaced workers a monthly average salary for up to two months as they search for a new job. In Indonesia, a job loss insurance programme provides displaced workers "financial assistance, reskilling opportunities, and job placement services".[175] Fairwork, an action-research project working on work standards in the platform economy around the world, has done research on how to set fair, inclusive and dignified standards for digital freelance and gig workers. Models already exist in some Arab region countries that could be adapted or expanded to support AI-displaced workers. For example, the United Arab Emirates has a form of insurance that provides financial support for workers in government-sector roles as well as private sector if they are terminated by their employers. In January 2025, the Government of Tunisia began consideration of a new law that would provide lost wages and other benefits such as healthcare insurance coverage and reskilling training for individuals laid off from their jobs.

Develop and implement programmes to build open-source AI skills for regional developers and users and networks to foster innovation collaborations among them

Open-source AI allows countries to develop their own technology with greater ease and greater diversity of innovation inputs, reducing reliance on for-profit external providers and giving countries more control over their digital future. Open-source models can be more readily adapted to local languages, industries and priorities than proprietary AI, without restrictions. This makes AI development more accessible, not requiring owning expensive servers or having a major AI company. As the open-source market has grown from $8 billion in 2019 to $100 billion by 2025, the region has an opportunity to use it to shape AI in ways that serve its needs.[176]

Training programmes focused on how to engage in and leverage open-source AI innovation would enable thousands of professionals, students and researchers to take part in this collective effort, strengthening local expertise and expanding economic opportunities. Training should focus on practical skills to develop, adapt and apply open-source AI. Participants of the training programmes should learn how to contribute to shared AI projects, customize models for local use, and integrate AI into industries such as healthcare, finance and governance, in their own languages and regional context. Use of networking technologies, blockchain applications and AI frameworks should be core topics. The demand for these skills is already growing, with nearly half of hiring managers seeking networking expertise and 55 per cent prioritizing formal training. To ensure responsible development, people in these training programmes will also need to understand the security, governance and ethical considerations related to integrating code from external sources into their work. This will be particularly important for open-source-developed applications being used in sensitive use cases involving, for example, users' personally identifiable information or other personal data, or provision of services impacting public safety.

Foster a synergistic AI-enabled tech sector throughout the Arab region through training in innovation management

A strong AI ecosystem depends not just on engineers but also on professionals who can connect technology with real-world needs. Innovation managers play a key role in making

AI development align with market demand, user needs and national priorities. Without expertise in business strategy, funding and commercialization, AI research can struggle to create meaningful impact.[177]

Innovation management training should build competencies in developers and entrepreneurs that support AI commercialization and adoption. Programmes should teach market analysis, business model development and funding strategies to help AI projects transition from research to scalable solutions. Training should also emphasize user-driven design, ensuring that AI apps are developed with real-world usability in mind. Additional focus areas should include managing intellectual property, forming partnerships, and integrating AI with existing business structures.

The global economy is already in early stages of a transformative evolution through convergence of technological advancements in AI, virtual reality, blockchain and robotics. Combining generative AI and other types of AI with these technologies will unlock unique, interactive digital experiences across sectors such as retail, financial services and healthcare. Innovation management training programmes created under this recommendation should provide participants a baseline understanding of these other technology areas and how they leverage AI. They should provide skills for conceiving and operationalizing business models for new product and service innovations at the intersections of AI, VR, blockchain and robotics.

Governments should collaborate with local universities, research institutions and industry to develop specialized programmes in innovation management. Programmes should be accessible to both technical and non-technical professionals, ensuring that AI researchers, policymakers and business leaders can work together effectively. Training should incorporate case studies, project-based learning and mentorship from industry experts to provide hands-on experience.

6

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Key findings, key messages and recommendations

In this section, drawn from the four preceding chapters, are key findings, key messages and recommendations, organized by the type of recommendation that each primarily represents. Most recommendations have more than one dimension. For example, some policy recommendations also encompass an investment dimension or a technical dimension. Similarly, some investment or technical recommendations also encompass a policy dimension.

Each recommendation also indicates the categories of key stakeholders that will be instrumental in carrying the actions forward. Stakeholder types noted are national-level policymakers, State and municipal-level government officials, private sector, civil society organizations, international governmental organizations and international finance institutions, and academia. Finally, each recommendation also supports one or more of the SDGs.

Policy, legislative, and regulatory recommendations (P)

1

Key finding

Many countries are implementing regulations to ensure the alignment of artificial intelligence (AI) with their societies' ethics and values, and to manage the safety and security of AI systems. However, fewer than 10 per cent of the 138 countries surveyed score above 50 on an index (1–100) on responsible AI measures.

Key message

Establishing standards for ethics, safety and security before globally-sourced models and applications are readily accessible in the Arab region's AI ecosystem will help ensure countries can leverage the benefits of AI in ways that align with the region's cultures and values.

Recommendation

Draft, adopt, and implement an "Arab Region Charter for Responsible AI" as a foundation for ethics, safety and security in the local development of AI and in adaptations of partners' AI innovations, as well as in the use of AI applications from any source.

Key stakeholders

National-level policymakers, intergovernmental organizations and international finance institutions, academia.

2

Key finding

More than 80 countries around the world, with a high degree of diversity in terms of their geographies, cultures and industrialization levels, are actively developing AI capabilities, models and applications with a focus on innovation.

Key message

Innovations from a wide variety of sources will enable entrepreneurs, corporate leaders, Governments and others in the Arab region to ensure their adaptations of AI are the best available solutions with the maximum potential to improve over time in service of local priorities.

Recommendation

Diversify partnerships for AI innovation to include a wide range of countries from the Global South, especially Africa, including triangular cooperation alliances that also involve international organizations, high income countries and businesses.

Key stakeholders

National-level policymakers, private sector, intergovernmental organizations and international finance institutions, State and municipal government officials.

3

Key finding

The ability of AI to expand access to education and create personalized adaptive learning experiences can improve job skill development. Nineteen Arab region countries joined together with the United Nations Educational, Scientific and Cultural Organization in an initiative to promote the integration of AI tools into their national education systems.

Key message

New means of training and education enabled by AI will make job skill development available to millions of people, helping solve one of the fundamental problems contributing to unemployment and underemployment in the Arab region.

Recommendation

Establish a region-wide job skill programme leveraging AI tools to empower and enable the demographic wealth of the region for future work and entrepreneurship.

Key stakeholders

National-level policymakers, State and municipal government officials, private sector, civil society organizations, intergovernmental organizations and international finance institutions, academia.

4

Key finding

In 2023, there was a 59 per cent rise over 2022 in the number of open-source AI projects on the most popular open-source site, and nearly two thirds of the AI foundation models released were open-source. Data regulations around the world are increasingly being structured to protect individuals' privacy while also promoting open-source innovation.

Key message

Given the foundational role of data in enabling AI innovation, opening up data sharing across the Arab region in a structured way will fuel solutions to the SDGs. Concurrently, the individuals and organizations generating data must be protected.

Recommendation

Harmonize data legislation across the region to promote sharing of data on open-source platforms, encouraging AI innovation for advancing the SDGs.

Key stakeholders

National-level policymakers, private sector, civil society organizations, academia.

5

Key finding

A growing number of AI and other digital platforms and tools perform social listening functions as a means of increasing public participation in governance and policy decision-making in communities and in humanitarian operations.

Key message

The data collection and analysis capabilities of AI can amplify citizen voices in decision-making processes both in matters of everyday societal governance and in disasters or other situations where Governments or other parties need urgent citizen input to ensure responsiveness and equitable outcomes.

Recommendation

Employ AI tools in social listening applications to enhance citizen-government engagement, social cohesion, and disaster and other humanitarian relief efforts.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, civil society organizations.

6

Key finding

Around 35 per cent of businesses have adopted AI technologies in their operations and job roles, and another 42 per cent are considering AI for future implementation. AI is being used by more than 50 per cent of companies with over 5,000 employees. Job roles in 90 per cent of government organizations surveyed globally are already using or exploring using AI.

Key message

Jobs in every sector in every country in the Arab region are already integrating AI and its usage will increase rapidly over the next decade, creating a mismatch between workers' skills and the skills they need, which needs to be addressed.

Recommendation

Develop a region-wide interconnected set of programmes to train individuals with the skills needed to work as users and developers of AI in job roles throughout the private and public sectors.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, civil society organizations, academia.

Key finding

An expected 83 million jobs will be lost globally as a result of AI, while 69 million new jobs will be created. Generative AI has the potential to automate up to 300 million full-time jobs in the United States and Europe. Arab region countries can expect similar levels of job loss impacts, relative to the sizes of their job markets.

Key message

The unemployment and underemployment situation in many countries in the Arab region will be exacerbated by job displacement from AI across all sectors. Actions to help people maintain their quality of life are needed as they take steps to secure new jobs, including jobs that might be created by AI development.

Recommendation

Implement legislation in Arab region countries to provide safety nets for workers displaced due to AI and establish fair working conditions for digital freelance and gig labour as it is increasingly impacted by AI.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, civil society organizations.

Investment Recommendations (I)

Key finding

At least 15 ESCWA member States have national visions or were developing one in 2024, and the majority have adopted the vision of the 2030 Agenda for Sustainable Development in these national development plans. More than half of ESCWA member States also have national AI strategies, and others are working on strategies or other national-level AI frameworks or guidance.

Key message

Structured mechanisms for aligning AI innovation initiatives with specific national goals and for measuring their results over time will help public sector officials and other leaders harness the full power and potential of AI for the improvement of societal wellbeing.

Recommendation

Devise and adopt a tool that countries in the Arab region can use to operationalize linkages between their AI strategies and national visions or long-term development plans.

Key stakeholders

National-level policymakers, State and municipal government officials, academia.

2

Key finding

The main Internet source of training data for most large language models is between 50–70 per cent in English. Arabic language websites represent less than 1 per cent of the world's total, and Arabic is not in the top 15 languages represented online.

Key message

Lack of available digital data and content in the Arabic language will threaten the region's place in the global digital economy and impede efforts to preserve and promote Arab cultures.

Recommendation

Scale Arabic language digital content for AI models and applications by promoting the production and curation of Arabic multimedia outputs, connecting and opening Arabic digital knowledge platforms and archives, and supporting production of localized datasets.

Key stakeholders

National-level policymakers, State and municipal government officials, private sector, civil society organizations, academia.

3

Key finding

The number of Arabic language-centric large language models in development is growing but efforts face challenges that are specific to the language, including dialect and colloquial differences and a shortage of Arabic digital data. Smaller models have been proven to be highly capable of leveraging customized local datasets for AI applications adapted for linguistic and cultural relevance.

Key message

AI models and applications reflecting the full range of Arabic dialects will unlock billions of dollars in economic opportunities throughout the region and open the digital economy to millions of Arab region residents currently at its margins, many of whom represent the next generation of the region's AI and digital workforce.

Recommendation

Coordinate public and private sector efforts to develop generative AI tools built on Arabic language-centric content within an ecosystem of small and large language models and action models that are reflective of diverse dialects and other cultural contexts.

Key stakeholders

National-level policymakers, private sector, civil society organizations, intergovernmental organizations and international finance institutions, academia.

4

Key finding

Successfully advancing complex research requires diverse research capabilities, perspectives and access to resources. International collaborative efforts have been proven to contribute to the growth of science, knowledge and innovation.

Key message

Sharing of knowledge and expertise among researchers and innovators with diverse perspectives and backgrounds will accelerate AI and other scientific and technical outcomes in the Arab region while also promoting beneficial cultural exchange.

Recommendation

Establish a regional AI researcher exchange programme.

Key stakeholders

National-level policymakers, private sector, academia.

5

Key finding

AI models generally perform better when trained and used in a user's native language, with superior understanding of nuances and cultural context generating more accurate and relevant responses. However, their performance is highly dependent on the quality and quantity of training data and other factors.

Key message

As digital tools increasingly become the norm for the provision of many essential government services, and more such tools use Arabic dialects to improve accessibility and quality of services for citizens and residents, officials must have confidence that the AI models powering the tools are as effective as the top global models.

Recommendation

Establish a rigorous testing and evaluation programme to validate Arabic language large language models for preferred use in the provision of government services in the Arab region countries.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, academia.

Investment recommendations (I)

1

Key finding

The culture sector comprises 6 per cent of the global economy with estimated annual revenues of more than $4 trillion per year. In the Arab region, cultural heritage tourism and other forms of tourism was a $275 billion market in 2024, projected to grow to more than $450 billion by 2034. While countries in the region are investing billions in AI-enabled culture and tourism initiatives, there are no notable multi-country or region-wide efforts.

Key message

Shared efforts and shared resources on AI for cultural heritage preservation will fuel multi-billion dollar opportunities in Arab region countries' creative sectors and build bonds of recognition and empathy across the region's diverse populations and with international peers.

Recommendation

Establish a regional fund for designing and implementing a region-wide collaborative project and platform on "Arab cultural heritage: past, present and future – enabled with AI".

Key stakeholders

National-level policymakers, State and municipal government officials, private sector, civil society organizations, academia.

2

Key finding

Agriculture- and food-related use cases are the second highest growth area for AI development after healthcare. More than 50 AI use cases are impacting the SDGs, mostly related to agriculture and food security, offering improvements in optimizing water usage, crop monitoring, yield management, input cost savings, reducing waste and others.

Key message

Strengthening the Arab region's capacity for food security can lead to addressing other critical SDG challenges. AI has unique abilities to power future means of ensuring sustainable agricultural practices and sustainable food supply chains.

Recommendation

Establish a network for regional research on AI for sustainable agriculture, linking and scaling promising initiatives and AI innovations that address food security.

Key stakeholders

National-level policymakers, private sector, civil society organizations, academia.

3

Key finding

Open-source AI usage among developers and researchers is rising substantially, with many preferring open-source frameworks over proprietary options. More than 80 per cent of companies are building 25 per cent or more of their AI tools on open-source platforms, and thousands of software development teams around the world have experimented with open-source AI.

Key message

Open-source AI allows entrepreneurs and others to fully customize their work without relying on infrastructure or other resources beyond their control, enabling them to learn from a global community and adapt their applications and innovations to suit unique situations and specific local requirements.

Recommendation

Develop and implement programmes to build open-source AI skills for regional developers and users and to build networks to foster innovation collaborations.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, civil society organizations, academia.

4

Key finding

Combining different digital technologies in new ways creates whole new industries and societal advancements, from ride-sharing (combining smartphones, geolocation and secure payment) to smart cities (combining machine learning, 5G, cloud computing and more) and many others. Innovation management training across a range of industry sectors improves companies' and individuals' ability to conceive and realize innovations.

Key message

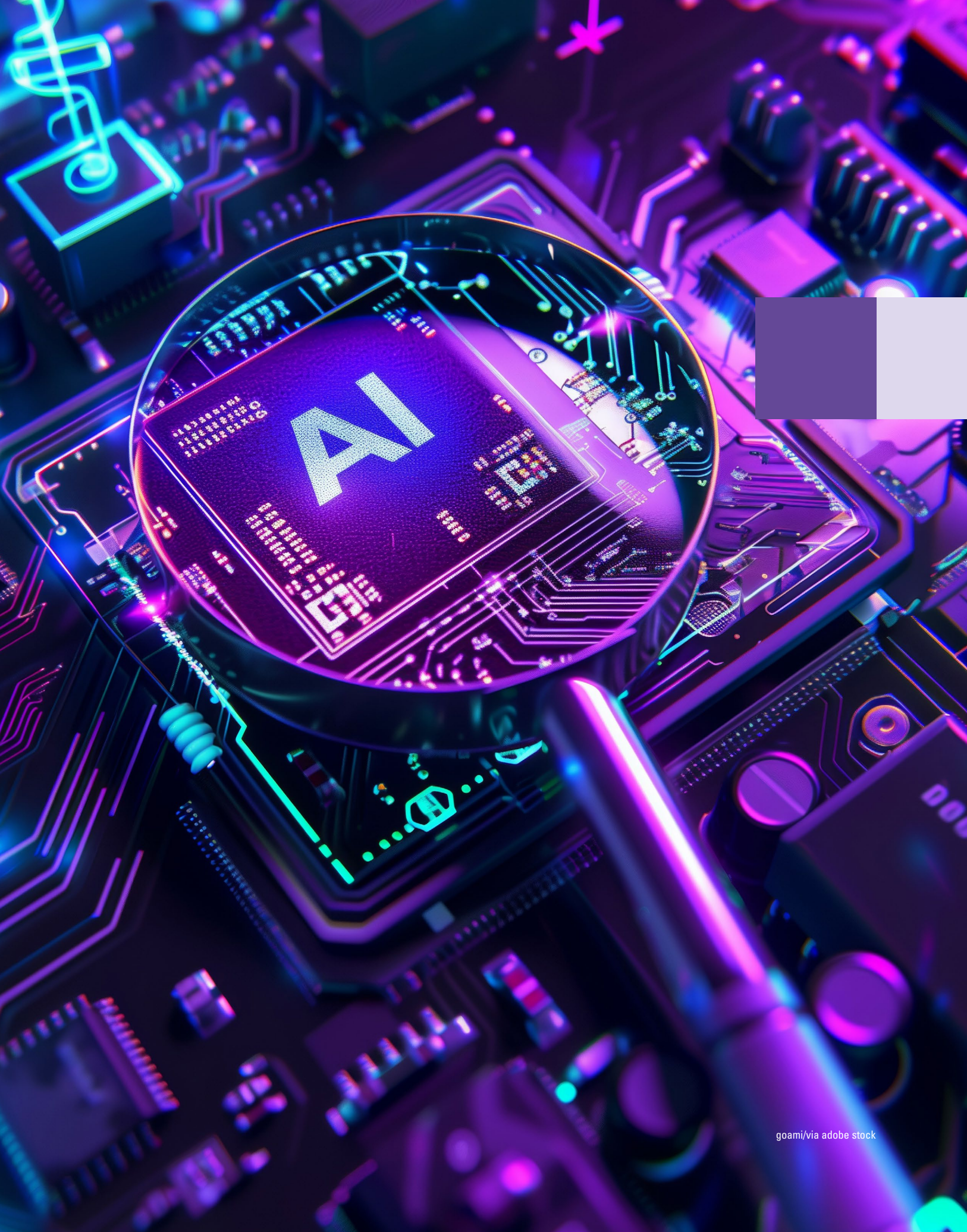
Alongside the development of necessary AI-specific technical skills, training on the business and innovation management aspects of the broader ecosystem of interrelated digital technologies like Metaverse and blockchain will enable entrepreneurs in the Arab region to identify and create new opportunities to drive meaningful local economic growth.

Recommendation

Foster a synergistic AI-enabled tech sector throughout the Arab region through training in innovation management.

Key stakeholders

National-level policymakers, State and municipal-level government officials, private sector, civil society organizations, academia.



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Annex 1. Illustrative adaptations of AI for selected national vision goal areas in Arab region countries

The breadth and diversity of goals across the national visions of Arab region countries are considerable. The ways in which AI could be most meaningfully adapted will be different for different goals and different countries. Understanding and considering what AI adaptations to national goals might look like can help inform leaders' thinking and decision-making. Several such adaptations are provided below as illustrative case studies. They depict what might be possible in the future, and in some cases, what is already being explored. In each case, the illustrations describe why the areas of effort are distinctively important in the Arab region; how AI can help create new kinds of valuable outcomes; and examples of where countries are already adapting AI innovations in these areas.

These case studies were selected because the goal areas – transportation, water resource management and energy – are represented in some Arab region countries' national visions. The aim with these case studies is not to be prescriptive, but rather, illuminative. Each country will make decisions about which national vision goals to focus on as top AI adaptation priorities, in the near term and over time as AI continues to advance.

Adapting AI transportation sector goals: traffic and congestion management

Traffic congestion in large cities around the world, including Cairo, Baghdad and Riyadh, is a growing concern. Negative impacts include high carbon emissions, health conditions caused by emissions and workers' lost productive time. It impedes national vision goals of environmental sustainability, healthy populations and economic growth. An average car trip in Dubai takes 30 per cent longer than it should due to traffic congestion. Urban transportation systems in the Arab region on average score 34 out of a possible of 60 in terms of efficiency. Residents of Riyadh lost nearly 90 hours of productive time in traffic in 2023.[178]

A number of AI innovations have already been developed and are in stages of being deployed in cities around the world that can help reduce traffic congestion and its negative impacts. The majority of these tools focus on predictive traffic modelling, analysing large volumes of historical and real-time data to enable urban transit officials to take actions in real time, such as adjusting traffic signal timings in anticipation of congestion conditions. Tools and algorithms can analyse data on public transportation usage in real time to adjust train and bus frequencies and make other adjustments in supply relative to demand. Improved public transit effectiveness can be a contributing factor in people shifting from personal automobile usage, improving traffic congestion problems. Another example of the growing future impact of AI on traffic congestion is the monitoring of highway traffic with AI sensors, enabling push notifications to motorists of incidents to enable them to reroute to avoid unexpected congestion. As e-commerce grows in cities and streets are increasingly congested by delivery trucks, AI can be used as it is in Rotterdam, the Netherlands, "to optimize the movement of freight trucks and ensure that their delivery occurs on time without jamming the city streets".[179]

Adaptation of AI to address traffic congestion is growing around the world, helping countries make progress on goals like reducing carbon emissions and improving quality of life for urban residents. The German cities of Mönchengladbach and Hamm are using a product that monitors traffic from deployment sites at intersections and along stretches of road. The system controls the timing of traffic lights and can detect when approaching emergency vehicles require a sustained wave of green lights to respond to incidents. The city of Verona in Italy is piloting a similar AI-driven intelligent sensor system: "by integrating data from radar and cameras within each sensor, the AI enables the system to classify different types of vehicles, bringing a new reliable level of precision to traffic tracking and management".[180]

AI adaptations for traffic congestion management are making headway in the Arab region. In Abu Dhabi, the Government's Integrated Transport Centre is engaged in two projects with Google. One collects and analyses data at intersections, while the second uses Google's AI platform with large datasets from Google Maps to "predict traffic patterns and develop proactive plans to minimize them".[181] In Saudi Arabia, the Arriyadh Development Authority has embarked on a $100 million project with the United States -based company TransCore for an AI-driven traffic control system at 350 intersections in Riyadh. The system "combines data, real-time communications, and analytics to handle traffic conditions" for day-to-day management and to help agencies coordinate responses to emergencies.[182]

Adapting AI to transportation sector goals: road safety

Road safety is an acute problem in the Arab region. The Arab region in 2019 had the highest traffic death rate in the world at 17.7 deaths per 100,000 people per year. Efforts are underway in a number of countries to address the problem, focusing on factors like driving behaviour, infrastructure issues and stronger enforcement of traffic laws. AI innovations can play a role. Enhancing road safety would save lives and also generate significant economic upside, projected in GCC countries alone at 3,000 fewer deaths per year and a savings of $250 billion over 20 years through lower material losses, lower healthcare related and insurance costs, and other factors.[183]

The same kinds of AI applications that optimize traffic flow to reduce congestion can also provide road safety benefits. For example, AI analysis of traffic data can not only predict gridlock before it emerges but also identify high-risk stretches of road where accidents are more likely to occur, enabling urban planners to reengineer these areas. The International Road Assessment Programme, a United Kingdom-based non-profit, has begun implementing this in its AI for Road Safety project. The project uses machine learning to analyse an extensive database of geolocated crash, road attribute and other data to generate risk maps of road networks and assign safety performance metrics to areas within the road networks. Planners in cities globally can use these assessments to design and build safety improvements to roads and streets.

There are a number of other AI applications that can increase road safety. Some focus on analysing and influencing driver behaviour, or triggering automations in a vehicle to act on the driver's behalf. A growing number of newly produced cars have built in AI-powered advanced driver-assistance systems like adaptive cruise control, automated emergency braking and pedestrian detection that can analyse data from cameras, sensors and radar to make split-second decisions that help prevent accidents. Another recent innovation is AI dashboard cameras that monitor and warn against drivers' actions that may create hazardous conditions, such as mobile phone usage or erratic or aggressive lane changes. In July 2022, the General Safety Regulation of the

European Union legislation mandated the inclusion of these AI technologies in new vehicles. One is intelligent speed assistance, which "informs, warns, and discourages the driver from exceeding the local speed limit". Another is driver monitoring systems, which "use cameras and AI to track eye movement, head position, and facial expressions, and alert drivers when signs of distraction or drowsiness are detected".[184]

AI road safety innovation is beginning to emerge in the Arab region. One example is from Saudi Arabian startup Hazen. They have developed AI-powered video analysis software deployable along roads and streets that "can spot everything from sudden lane changes, to drivers not wearing seatbelts or using phones".[185] Their technology is in use in Egypt, Oman and Saudi Arabia, and is poised to begin operations in Argentina, Nigeria and the United Kingdom. It received an award from the International Road Federation in 2020 for the impact it is already having and the potential for that impact to scale in support of public safety goals.[186]

Adapting AI to water sector goals: wastewater treatment

The Arab region is the most water-stressed region in the world. Water scarcity is projected to worsen considerably in the coming decades. Among the projected impacts is that "climate-related water scarcity could lead to economic losses equalling up to 14 per cent of the region's GDP" by 2047.[187]

Significant work is advancing to develop AI applications to address water scarcity in a variety of ways. AI tools are capable of analysing large datasets of historical data and real time activity from sensors in water systems to optimize water distribution, detect leaks and anomalies in water flow and pressure, predict future demand, and more. In agriculture, "AI-powered irrigation systems represent a paradigm shift, as they can optimize water usage by considering various factors such as weather patterns, soil conditions, and plant water requirements"[188] in integrated analytic models. AI sensors can monitor the quality and safety of water supplies by detecting pollutants and other concerns, with a granularity unachievable by other means. Numerous other use cases for AI in water management are being identified and deployed around the world.

One application area that could be particularly impactful in Arab region countries is in wastewater treatment, enabling greater volumes of water to be reused for irrigation in a region where agriculture accounts for 85 per cent of water usage. For example, "AI algorithms can analyze sensor data to predict equipment failures, optimize chemical dosing for better treatment performance", and "optimize energy usage, leading to significant cost savings and reduced environmental impact".[189] Machine learning models have been piloted and show promise in a variety of aspects of wastewater treatment including managing the by-products of disinfection and chlorination, improving filtration techniques used for removal of contaminants in wastewater, and employing AI algorithms to analyse data from Internet of Things sensors to predict equipment failure.

Globally, most wastewater treatment plants have yet to update their systems to utilize the technology. One that has done so is in Cuxhaven, Germany, using an AI-based system to analyse data in the plant's supervisory control and data acquisition system to optimize its aeration and other operational processes to reduce energy and chemical use. DARROW, a project funded by the European Union for employment initially in four countries, is working on similar objectives. It is developing AI tools "to identify the right amount of air depending on the composition of the water, so it can be treated using as little energy as possible".[190] DARROW will also enable predictive maintenance of critical control systems in treatment plants. In the United States, the city of Valencia is piloting AI-based water quality prediction models in its drinking water treatment plants to anticipate events that may disrupt operations and to recommend optimal chemical doses and prevent deterioration of plant equipment.

In the Arab region, the International Water Management Institute is working with Google on e-Rewater, a programme to improve wastewater reuse by employing AI with sensors to evaluate sources of water for contaminants. It is also creating an online dashboard for utility managers and policymakers with accessible and comprehensive information on wastewater generation and recycling potential in Egypt, Saudi Arabia and the United Arab Emirates. In 2020, UNDP partnered with the Tubas Joint Service Council for Water and Wastewater and Palestine-based startup FlowLess on a project to test an AI and Internet of Things-based system for detecting water losses. In 2024, two Jordanian teenagers developed an AI-based smart water filtration tool that purifies wastewater for reuse in irrigation and mitigates soil and crop damage issues. The project was recognized with an award by Codeavour, an organization that sponsors AI and coding competitions for young people.[191]

Adapting AI to water sector goals: desalination

Desalination is a major source of drinking water in many countries in the Arab region – 40 per cent in the United Arab Emirates, 70 per cent in Saudi Arabia, and nearly 90 per cent in Bahrain and Oman, but other countries in the region rely on it as well. Ten countries already have operational desalination plants and Jordan is underway on plans for a new megaproject. Cost and negative environmental impacts are two key issues with desalination. With both, AI can make a major difference.[192]

Desalination involves complex, costly and time consuming processes. In simple terms, it involves forcing seawater through semipermeable membrane materials under high pressure. It also requires complex pre-treatment of the seawater to remove bacteria and other matter that can damage the membrane. AI can make these processes more efficient by determining the precise sequence in which individual atoms should be removed from the membrane, "creating the most efficient geometry of each pore for the process".[193] The intensive energy demand of desalination is a key element of both the cost and the environmental impact, and AI can address this. The optimization of the flow of atoms through the membrane reduces the energy consumption of the process. Researchers in Spain have made advances with an AI system that optimizes fluctuating electricity prices and renewable energy availability to enable integration of solar and other non-fossil fuel sources into desalination plant operations. As more countries in the Arab region transition to renewable energy and take advantage of the solar energy potential of the region's abundant sunlight, this will reduce the cost and emissions impact of desalination operations in which the share of renewable energy was only 1 per cent in 2016.[194]

AI-enabled desalination is beginning to emerge globally. In Europe, where there are more than 2,000 operational desalination plants, there is growing investment in the necessary research and development. Recent reporting shows more than 20 million Euros under the Horizon 2020 programme for tech innovation research and development for desalination. In Singapore, the National Water Agency and the National Research Foundation engaged the water resources engineering firm Gradiant in 2024 to design, build, and operate a new desalination facility employing the firm's SmartOps AI technology to reduce the energy consumption of operational processes in the plant. SmartOps uses machine learning algorithms to optimize and predict plant operations. Synauta, a Canadian AI water technology company has been working for five years with desalination facility operators in the Arab region, Australia and Europe.[195]

In Bahrain, a new Hidd Independent Water Project is expected to go under contract for construction in 2025. A French company has been engaged for a new Hassyan seawater desalination plant in Dubai, scheduled to start operating in 2026. Saudi Arabia and the United Arab Emirates announced plans in 2023 for $14 billion and $10 billion in desalination projects, respectively; Saudi Arabia aims to invest $80 billion by 2030. A project in Jordan will build a plant on the Gulf of Aqaba, expected to increase the sovereign desalination capacity of Jordan from 4 billion to 350 billion litres a year.[196]

Adapting AI energy sector goals: smart grid and variable energy optimization

Transition to renewable energy is underway in the Arab region, as it is around the world. It is both urgent and a source of economic opportunity due to soaring energy demand; decarbonization commitments under the Paris Treaty; considerable natural resources (sunlight and wind) enabling the region to become both a large-scale user of renewable energy for domestic demand, and an exporter; and others. However, the intermittent availability of solar and wind power, and the asynchronous interconnection of outputs to electricity grids, makes increasing the share of renewables in the energy mix difficult. AI can help address some of the technical challenges inherent in the transition to variable renewable energy.[197]

The ability of AI to analyse massive datasets from multiple sources at exceptional speed drives numerous value propositions for countries working to transition to variable renewable energy. Leveraging historical and real-time data across the energy value chain, from generation to transport, storage, distribution and consumption, AI offers unprecedented capabilities. It can analyse energy demand as it happens and predict future demand, helping producers and utilities address mismatches before problems occur. This enables real-time adjustments to variable renewable energy output at the generation point, as well as storage optimization. AI can monitor and diagnose infrastructure system problems, enabling predictive maintenance. In the wind power context, AI models can predict wind behaviour with high precision, enabling operators to adjust turbines in real-time, maximizing energy capture and also profitability. AI can also determine the optimal placement and design of renewable energy assets.[198]

Use of AI in smart grid optimization and to accelerate integration of variable renewable energy into countries' energy mix is moving forward rapidly. United States-based firm Siemens Gamesa, operating in 90 countries around the world, employs AI models to continuously adjust operations in their offshore wind farms to maximize power output while minimizing cost. DroneDeploy uses AI-powered software in its aerial drone platforms to "evaluate solar farm layouts to maximize energy generated per site, and automatically monitor the health of solar panels and other equipment in the field".[199] In Indonesia, State-owned electricity utility is underway on a pilot project to use AI for predictive maintenance of power plants throughout the country. Independent Indonesian power producer Star Energy has integrated AI analytics into the operations of its geothermal power plants to optimize efficiency and reliability in their energy production. Eneryield, a startup in Sweden, is providing grid operators with predictive and real-time maintenance to reduce unplanned outages, using a proprietary machine learning prediction technology that "seamlessly integrates into existing power networks without requiring additional hardware".[200]

AI-enabled smart grid deployment is beginning to accelerate in the Arab region, particularly in Saudi Arabia and the United Arab Emirates but also in Egypt, Jordan, Morocco and others. Saudi Arabia recently published a National Smart Grid Roadmap outlining plans for deployment over the next two decades, and the State-owned and operated Saudi Electricity Company is underway on nationwide installation of 10 million smart meters. In Dubai, the Electricity and Water Authority has begun integrating AI into smart grids that have been installed in the city over the last decade. The Automatic Smart Grid Restoration System is an AI-enabled autonomous fault detection and service restoration technology, part of the United Arab Emirates smart grid strategy updated in 2021. An ongoing project in Egypt is set to become the Arab region's first-ever country-wide smart grid.[201]

Adapting AI to energy sector goals: green hydrogen

Green hydrogen is another renewable energy source that can help countries meet their transition goals and commitments, meet the booming domestic demand for energy and other economic growth objectives. At least five countries in the Arab region (Egypt, Morocco, Oman, Saudi Arabia and the United Arab Emirates) are exploring green hydrogen as part of their future energy strategies. AI has the potential to make green hydrogen more viable.[202]

With green hydrogen, the electricity used to power the electrolysis process comes solely from renewable energy sources like solar or wind for zero carbon emissions. Electrolysis involves multiple complex and costly processes. AI can help address both factors. "AI algorithms optimize these processes by forecasting and regulating the parameters that impact the yield and quality of hydrogen. This reduces energy consumption and enhances the efficiency of production."[203] Another complexity lies in using renewable sources in a production process at scale, given the intermittent nature of wind and solar. AI algorithms can be used by green hydrogen producers to "aid in forecasting the availability of these sources, thereby optimizing hydrogen production".[204]

AI can also play a role in making green hydrogen viable as an energy export for producer countries. The difficulties in export lie in the fact that "transporting hydrogen requires supercooling it, compressing it, or carrying it in another, more manageable form such as ammonia".[205] AI can optimize the production of blue ammonia just as it does for the green hydrogen production. Research by the United States Department of Energy "tasked with investigating organic molecules for suitability as liquids to carry hydrogen (to make transportation safer and easier)" used AI to "narrow from 160 billion possibilities to 41 molecules in 14 hours". The computation would have required five years in a conventional computer-based analysis without AI.[206]

AI to simplify and scale green hydrogen is advancing in important ways. In Scotland in 2020 and 2021, a project called HyAI employed AI algorithms to optimize production at the European Marine Energy Centre. By analysing weather data, electricity prices and energy usage to predict power costs and user demand, AI maximized cost-effectiveness and minimized grid stress. A follow-on HyAI 2.0 project is underway to pilot real-time control of hydrogen production using AI. In 2024, Siemens introduced a generative AI-powered chatbot, Hydrogen Plant Configurator, enabling engineers to create optimized plant designs. AI is used to predict plant-specific key figures such as possible power consumption, heat generation and other factors critical to planning and operating a more sustainable hydrogen plant.[207]

In the Arab region, five countries are actively working on green hydrogen. Saudi Arabia is making significant investments, and one market research estimate projects a compound annual growth rate of 50 per cent between 2023 and 2032 for the country's green hydrogen industry. As part of the NEOM development, Saudi Arabia is building the world's largest green hydrogen production plant, projected to be operational by the end of 2026. At COP27 in 2022, Egypt signed nine agreements, including a

joint statement on a European Union-Egypt renewable hydrogen partnership. Through these, Egypt will explore the potential development of green hydrogen and green ammonia production plants that would comprise more than $80 billion in investment and produce nearly 3 million tons of hydrogen annually. In 2022, Oman released a Strategy on Green Hydrogen, projecting $140 billion in investment over the next 30 years aimed at producing more than 1 megaton of green hydrogen per year by 2030, rising to more than 8 megatons per year by 2050. These efforts can be accelerated and their impacts on energy transition and emission reduction goals scaled by leveraging AI.[208]

Annex 2. Additional AI use cases supporting the SDGs

SDG 1: No Poverty

AI for economic resilience in disaster conditions

In an initiative co-led by the ITU, World Meteorological Organization, and United Nations Environment Programme, AI technologies are transforming how communities prepare for, respond to, and recover from natural disasters. By leveraging advanced analytics and predictive modelling, AI technologies are aiding in damage assessment. By analysing satellite imagery and ground reports, they can help evaluate the extent of a disaster's impact in real-time. In resource allocation, they can help optimize distribution of critical supplies for equitable delivery of food, medical aid and housing materials to affected regions. In economic impact prediction, by powering models that assess potential economic losses, they can enable targeted support to be sent in advance of a disaster to the industries and individuals most at risk. In this initiative and others like it, AI is enhancing the efficiency and equity of disaster recovery, helping communities mitigate the economic setbacks that often push them into poverty after catastrophic events. One key benefit of applying AI in this context is more fair resource distribution; data-driven insights help ensure vulnerable populations receive adequate timely assistance. Another is improvements to economic stability, as AI predictions enable Governments to implement policies that reduce the financial impact of disasters, supporting long-term recovery. There are also beneficial outcomes to improve decision-making – integration of diverse data sources, from satellite imagery to local infrastructure reports, enables precise response strategies.[209]

SDG 2: Zero Hunger

AI to improve and secure global food supply chains

AI is contributing to addressing food security challenges and achieving the objectives of SDG 2 by enabling important improvements in global food supply chains. As food moves from production facilities to markets and stores to consumers, AI algorithms can monitor "critical control elements such as temperature and humidity to protect storage conditions and avoid costly mistakes like food spoilage",[210] defects in food products, unauthorized tampering and more. Major global players in the food supply chain like Amazon are already employing AI technologies for these critical food safety and security aims. As the technology advances it will be available to SMEs, even in rural farms and markets around in the world. The combination of Internet of Things sensors with blockchain technology and AI-powered data analytics tools also enhances supply chain transparency, recording every step in the journey from farm to table. These AI-enabled innovations can signal to human monitors when and where conditions exist that are putting food safety or timely delivery at risk and expedite intervention. In food manufacturing facilities, AI algorithms can analyse large sets of data from production lines, packaging processes and shipment preparation activities to improve product turnaround time, optimize inventory management, and enable predictive maintenance

of equipment. As food is en route from production facilities to consumers, AI can calculate the most efficient transportation routes, cutting fuel and other costs and helping ensure greater speed of delivery and confidence that communities will receive critically needed food. One key benefit of AI in food supply chain optimization is aligning supply and demand. AI can predict how much of different foodstuffs and products are needed in different places and enable data-driven decision-making to help prevent overproduction, shortages and miscalculations of delivery timings. Another beneficial outcome is reduced waste, as AI tools help minimize spoilage by optimizing storage conditions in facilities and during transport, increasing the amount of safe fresh food available to communities and individual consumers. AI in this use case also helps build consumer confidence – the transparency that AI provides as food moves through supply chains builds trust that producers and oversight officials are accountable for their responsibilities to meet communities' food needs.[211]

SDG 3: Good Health and Well-Being

Improving early detection and treatment of diseases affecting women

Among the many applications in the health context, four Cambridge University scientists recently outlined how AI technologies are transforming women's healthcare, specifically by enabling breakthroughs that are defining the future of early cancer detection. AI-powered tools can detect early signs of breast and cervical cancer through imaging and data analysis. Tailored AI recommendations for personalized treatment plans can optimize treatment based on patient data. Additionally, AI systems can continuously monitor, track, and assess patients' health to identify cancer risks and recommend timely interventions. The impacts of AI on women's health outcomes are significant. Early detection of breast and cervical cancer helps increase survival rates and reduce treatment complexity. AI facilitation of proactive healthcare measures also helps reduce mortality from preventable conditions. A third important benefit lies in empowering healthcare decisions, as patients receive informed, personalized care guided by AI analysis.[212]

SDG 4: Inclusive and Quality Education

AI-enabled learning in virtual reality environments

AI is enabling major advances in the integration of VR and AR into education, from primary through to university levels, with powerful results on learning outcomes. Enhanced visualization helps students grasp and retain complex concepts, perhaps most importantly in science, technology, engineering and mathematics fields. With the help of AI-powered 3D VR and AR tools, students can visualize these concepts in new and immersive ways, bringing learning to life and making it more engaging and exciting. These tools also make learning experiential. Students can engage in virtual simulations that range from exploring ancient archaeological sites, to conducting advanced scientific experiments as if they were in a world-class laboratory. This helps inspire their creativity and spark their imaginations. As these technologies continue to evolve, the scope and impact of immersive learning are expected to expand, offering even more innovative and effective educational solutions. AI is critical to enabling these kinds of 3D VR environments for educational and other purposes. It enables the processing of the huge amounts of data such tools rely on. AI also analyses students' physical movements in the classroom in real-time to translate them into actions in the VR environments, allowing them to interact in the VR. One benefit of these developments is enhanced engagement – AI-powered VR in educational settings provides memorable immersive interactive experiences. Learning in VR environments powered by AI can improve students' retention of information by engaging spatial cognition capabilities that are more productive and effective in learning than other forms of cognition. A third benefit is in collaboration and social skills development – by creating exciting environments students can work in together, AI-powered VR learning improves teamwork and social skills.[213]

SDG 5: Gender Equality

Addressing gender bias and supporting women's empowerment through AI

One of the many ways AI technologies are contributing to progress around the world on SDG 5 is in helping bridge the gender gap by addressing biases in hiring, promotion and performance evaluations. These tools will help ensure that women have equal opportunities in the workplace, especially in male-dominated industries. One way in which this will be achieved is mitigating against bias in hiring. AI algorithms are being used to identify and reduce gender biases in recruitment processes, allowing women to have the same chances of being hired for roles as their male counterparts. AI tools can also be used to conduct performance reviews and identify potential biases that may disadvantage women in evaluations, promotions and pay. AI-driven platforms also help empower women through providing personalized access to online courses, career development tools, and financial services that help them start and grow businesses. One of the beneficial impacts of AI in this critical area is enhanced career growth – with fair evaluations enabled by AI tools, women can expect more equitable growth and development within their careers. It also supports economic empowerment, as AI platforms provide access to professional development and financial tools, enabling women to pursue entrepreneurial ventures and gain financial independence.[214]

SDG 6: Clean Water and Sanitation

AI for flood prediction and management

AI is being utilized around the world to predict and manage water-related disasters. One example is a use case ongoing from 2018 in Colima, Mexico. By analysing data from various sources such as sensors and satellite imagery, AI helps identify areas at risk of contamination and provides solutions for efficient water distribution during emergencies. AI algorithms are capable of uniquely powerful data analytics using these data sources to predict flood risks and detect contamination in water sources. During and after natural disasters, AI systems can help optimize distribution of available water resources for equitable access and help ensure that contaminated water is identified and purified, preventing the spread of waterborne diseases. The impacts include equitable access for flood-affected communities to clean water for drinking, sanitation and hygiene; reduction in waterborne disease risk; and improved disaster resilience as AI-driven flood prediction and water management systems help communities better prepare for and respond to natural disasters.[215]

SDG 7: Affordable and Clean Energy

Energy efficiency in smart cities

The use of AI in smart cities to improve energy efficiency is growing as fast as the growth of smart cities themselves. AI systems have increasingly powerful capabilities to analyse and integrate data from various sources such as weather forecasts, electricity usage patterns and occupancy levels to identify opportunities for energy saving. Leveraging these diverse data types, AI algorithms adjust energy distribution based on real-time demand, ensuring that energy grids are balanced and optimized for efficiency. AI can predict when maintenance is needed for energy infrastructure in smart cities by analysing usage patterns against equipment performance, reducing downtime and improving system reliability. The integration of AI into energy management is accelerating the aims of smart city development and their differentiation from traditional urban designs in a variety of important ways. One is through reduced energy consumption: optimizing energy usage enables smart cities to greatly reduce their overall energy consumption, helping lower greenhouse gas emissions. Another is by cost saving – efficient energy management leads to lower energy bills and operational costs for residents and businesses, making smart cities more economically sustainable. A third benefit is enhanced resilience, as AI-driven energy management systems strengthen urban energy grids, enabling them to handle fluctuations in demand and potential disruptions more effectively.[216]

SDG 8: Decent Work and Economic Growth

AI to empower SMEs

Micro-, small- and medium-sized enterprises (MSMEs) comprise the majority of economies in every region and most countries – 90 per cent of businesses, between 60 and 70 per cent of employment, and 50 per cent of GDP, globally. AI will be critical to the continued growth of MSME. It may even be key to their future viability, as many could be at risk of losing ground to larger competitors in the absence of the AI those competitors are already leveraging. Expansion of AI use will be vital to the ability of MSMEs to benefit from customer service automation and personalized marketing. It will help with their sales forecasting, enabling better inventory management, efficient resource allocation, and a greater ability to meet fluctuations in customer demand without overproduction or stock shortages. It will enable cost-saving automation in their bookkeeping and other operational functions. One example of AI tools custom-designed for MSMEs is from Chinese company Ant Group, which has developed an AI-powered recommendation engine that will empower MSMEs to connect with their target customers more effectively despite the resource constraints they face as small businesses. Impacts from greater AI use by MSMEs will be numerous. One is enhanced efficiency – integrating AI into operations will streamline workflows and reduce time and effort on laborious tasks, enabling MSME proprietors to focus on higher value-adding activities. A second is enhanced customer experience – because AI-powered chatbots enable MSMEs to offer 24/7 service, they can boost customer satisfaction and retention and thereby revenue growth. A third benefit is in data-driven decision-making. AI will help MSME proprietors identify patterns and trends in vast amounts of data both in internal operations and customer preferences, enabling better informed strategic decision-making and reducing risk of errors.[217]

SDG 9: Industry, Innovation and Infrastructure

Smart cities and innovation in Barcelona, Spain

Barcelona has implemented several AI-driven innovations to manage its urban infrastructure more efficiently, transforming itself into a smart city that optimizes resources and services for its citizens. These innovations use AI-powered Internet of Things sensors and data analytics to improve operations and outcomes in a variety of urban operations. AI-powered sensors reduce congestion by monitoring traffic patterns and adjusting traffic lights to improve flow. AI also helps monitor energy usage across the city, lowering environmental impacts by adjusting and optimizing the distribution of power and reducing consumption. In waste management, AI-powered Internet of Things technology monitors waste levels in garbage bins, enabling optimized waste collection routes and reducing unnecessary pickups. A new AI-Internet of Things solution, inteliLIGHT, "reduces street lighting energy expenses and power consumption by up to 40 per cent by adding intelligence and control to the lighting network".[218] Numerous impacts supportive of SDG 9 are being seen in Barcelona, and can be anticipated in other cities where AI is used in these ways. One is enhanced safety, as AI-driven real-time monitoring and predictive maintenance of infrastructure helps reduce the risk of failures, increasing public safety. A second is in cost savings, as proactive maintenance, along with optimized resource allocation, reduces costs for city administrators. A third benefit is in sustainability – through better management of energy and waste, AI applications help reduce CO_2 emissions and minimize other environmental impacts.

SDG 10: Reduced Inequalities

AI for secure financial services

AI is improving access to financial services. One example is in fraud detection. AI systems can monitor financial transactions in real time to detect and prevent fraud, helping ensure secure access to financial services. A growing number of machine learning

models are being developed and trained to "detect anomalies in customer behaviors and connections as well as patterns of accounts and behaviors that fit fraudulent characteristics".[219] Other tools are emerging that can "predict the next transaction of a customer, which can help payments firms preemptively assess risks and block fraudulent transactions".[220] The impacts on efforts to achieve SDG 10 objectives are already visible. One outcome is economic empowerment. By improving the security of individuals' and MSMEs' transactions, AI empowers individuals and businesses to grow, reduces poverty, and promotes financial stability. A second benefit is in risk management – AI helps financial institutions and individuals assess and manage risks more effectively, enabling services for and economic activities in underserved populations.

SDG 11: Sustainable Cities and Communities

AI for disaster resilient infrastructure

AI can enhance urban infrastructure resilience to natural disasters. Through risk assessments and predictive modelling, AI helps cities prepare for and mitigate the impacts of disasters like floods, earthquakes and hurricanes. AI analyses data from a wide variety of sources, including weather patterns, historical disaster data and current infrastructure conditions, to assess disaster risks. AI systems can create detailed vulnerability maps to identify areas and infrastructure at high risk, allowing cities to prioritize resilience efforts. A growing number of AI models are also being developed to serve in more real-time disaster prediction efforts, sensing and quantifying the likelihood and potential impact of natural disasters. AI models can then generate recommendations that enable the immediate deployment and allocation of disaster preparedness and recovery resources. The systems thus help strengthen infrastructure and reduce vulnerabilities. ITU is co-leading a new Global Initiative on Resilience to Natural Hazards through AI Solutions with four other United Nations organizations to advance research and development on such AI applications. Impacts on SDG 11 include enhanced resilience as improved risk assessment and predictive measures increase the ability of urban infrastructure to withstand natural disasters. Another benefit is in reducing the impact of disasters on communities.[221]

SDG 12: Responsible Consumption and Production

AI for sustainable supply chains

Applications are emerging for AI to optimize supply chains, making them more sustainable by reducing environmental impact and improving operational efficiency. Smart supply chain monitoring is a key part of what AI can do in support of SDG 12. AI tools are able to integrate data from all stages of an organization's or industry's supply chain, providing a real-time view of the environmental impacts throughout the process from production to delivery. In this monitoring and analysis, the AI tracks and analyses key metrics like carbon footprint, energy consumption and material/resource usage, providing valuable insights for optimization. AI systems can also help companies streamline and optimize resource allocation in their product manufacturing and distribution processes, helping ensure materials are used efficiently and minimizing waste. Based on data collected on these processes, AI provides recommendations for manufacturers and suppliers on how to adopt more sustainable practices, like reducing energy usage or switching to greener materials. It also helps with forecasting demand for product components and the final products themselves (reducing the risk of overproduction and over-shipment), and with automating inventory replenishment and inventory clearance. AI can thus reduce environmental impact as lower carbon footprints and reduced resource consumption lead to more sustainable production processes. A second benefit is improved efficiency, as AI-driven optimization reduces costs in supply chain operations while improving overall efficiency. A third is in the promotion of sustainable practices, as AI helps encourage companies across the entire supply chain to adopt greener practices, contributing to long-term environmental preservation.[222]

SDG 13: Climate Action

AI for experiential climate change education

AI is contributing to meeting objectives related to climate change mitigation and SDG 13 by powering hyper-realistic VR environments for experiential climate change education. A number of such VR applications have already been developed. They create an immersive and interactive experience that can help people understand and internalize the impacts of climate change in a fundamentally different way, experiencing these effects rather than simply reading about them. One example is a project by the United Nations Environment Programme, which has created an immersive VR experience of a user's personal carbon footprint, in a platform that integrates 3D graphics and full-sphere surround-sound. It confronts the user with their carbon footprint in the form of an orange ball of gas that can be as large as 18 metres high. Another example is from the non-profit Climate Interactive, which has created an immersive experience allowing users to explore and experience how solutions to climate change challenges might play out. They have engaged policymakers and business leaders, educators, the media and the public. VR environments for climate education are realizable in large part because AI helps create the synthesis of massive datasets needed to render the VR experiences. These new forms of AI- powered climate change education help create a sense of urgency, as the experiential component challenges people to think differently about the choices they make each day. They also inspire engagement: experiential learning about the potential effectiveness of different climate change mitigation solutions can magnify users' commitment to supporting those solutions. Finally, they are expanding the reach of climate change education to audiences such as the millions of video game enthusiasts around the world.[223]

SDG 14: Life Below Water

AI for marine pollution monitoring

AI is being applied to monitor and reduce marine pollution, a major threat to ocean ecosystems. AI-driven solutions are at the core of a growing number of unprecedented solutions for detecting pollution sources and monitoring the quality of water at risk from pollution. For example, AI systems can analyse satellite imagery and drone-collected data to detect various types of pollution in marine environments, including oil spills, plastic waste and chemical contaminants. These systems provide real-time detection of pollution sources in coastal and open water areas. Continuous real-time monitoring using AI also allows authorities to identify pollution hotspots and track changes in water quality over time, helping ensure quick responses to emerging pollution threats. Beyond detection and monitoring, AI algorithms can recognize patterns in pollution data, such as the density of concentrations of plastics found in remote ocean locations, helping to understand the sources, spread and long-term impacts of marine pollution. This is crucial for predicting future pollution events and guiding preventive measures. AI systems also generate alerts for authorities and environmental organizations, enabling them to take timely action in response to pollution events such as coordinating cleanup efforts and enforcing regulations. Such uses of AI in support of SDG 14 are producing important results. One is reduction of damage from threat sources – early detection of pollution sources and rapid intervention helps reduce the amounts of harmful substances entering marine ecosystems. Another is that AI-driven systems that integrate data from multiple sources can provide new kinds of insight into complex multi-species marine ecosystems. A third benefit is greater public awareness. AI to track and report pollution events leads to better-informed communities and their use of more sustainable practices.[224]

SDG 15: Life on Land

AI for forest management

One form of AI application in support of SDG 15 focuses on sustainable forest management. AI can analyse satellite imagery and data from sensors installed in forests to monitor their health in real-time. It can detect early signs of deforestation, diseases and

other threats such as wildfires, invasive species or illegal logging, allowing for rapid intervention. Importantly, AI can integrate data from various sources to create a comprehensive view of forest health and identify potential risks to ecosystems. With this kind of data-driven insight, responsible authorities and conservationists can optimize the allocation of forest management resources, helping direct efforts to the areas needing most attention. AI can also help coordinate reforestation projects and reduce unnecessary interventions in healthy ecosystems. AI models can predict how different factors such as climate change, human activities or disease outbreaks might affect forest ecosystems. These models help in planning long-term strategies for forest health and management. AI helps maintain the resilience of forest ecosystems by providing data and insights for better decision-making, ensuring the long-term survival of forests.[225]

SDG 16: Peace, Justice and Strong Institutions

AI for crime prediction and prevention

AI can be used to predict, analyse, and prevent crime, enhancing public safety and improving law enforcement strategies. Innovative breakthroughs in crime data analysis become possible when AI systems aggregate and integrate various data sources such as crime reports, social media activity, surveillance footage and other publicly available data. By doing so, AI can spot trends and emerging patterns. AI models can also be used to predict when and where crimes are likely to occur based on historical crime data, seasonal trends, demographic factors and other relevant inputs. This helps law enforcement agencies identify potential crime hotspots and times, optimizing the deployment of police patrols and other resources to the areas where crime is more likely to occur. This proactive approach improves the effectiveness of policing and reduces strain on law enforcement. AI-driven platforms can also facilitate communication and collaboration between law enforcement and local communities. These platforms can help raise awareness, engage citizens in crime prevention, and create safer environments through shared data and intelligence. In this dimension of SDG 16, AI is enabling impacts like reduced crime rates by predicting crime patterns and enabling proactive measures. It is also improving trust between communities and law enforcement agencies. A third benefit lies in how AI helps ensure limited law enforcement resources are used more effectively, improving the efficiency of policing efforts.[226]

SDG 17: Partnerships for the Goals

AI for sustainable development partnerships

AI can fuel cross-border and cross-sector partnerships in support of all the SDGs, individually and collectively. AI-driven platforms can provide open-data sharing capabilities allowing Governments, non-governmental organizations and private sector organizations to exchange valuable data related to the SDGs. AI systems can also enable collective analytics of shared data to identify patterns and trends that highlight opportunities that can be seized and scaled in multiple countries in mutually supportive ways. SDG progress will be accelerated as AI supports the planning and execution of initiatives that increasingly involve coordinated efforts bridging areas including education, renewable energy and poverty reduction. AI will also help to evaluate the impacts of collaborative projects and initiatives, providing actionable recommendations to improve outcomes and make development efforts more effective. The AI for Good initiative is an example of a global partnership that is promoting the use of AI in SDG implementation, and also itself using AI to fuel its mission. The Global Partnership for Sustainable Development Data is another – "a network of over 700 private sector, academic and civil society organizations, and governments", leveraging AI to advance its aim to "ensure that data can be put to good use to achieve the SDGs".[227] The impacts of AI on fostering partnerships in support of the SDGs will be considerable. It is already enabling enhanced decision-making. AI-supported analysis of data generated and leveraged by networks of development-focused organizations helps them make informed decisions and prioritize initiatives based on need and impact. It also creates resource efficiency benefits – by optimizing the use of resources in joint initiatives, AI helps reduce waste and inefficiency, contributing to more effective and sustainable outcomes.

Endnotes

1. This Executive Summary is drawn from the balance of the report that follows. Citations for all quoted content appearing in this Executive Summary, and all other content in it that requires citation, are provided in the subsequent chapters 1 through 5 where that content appears.
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